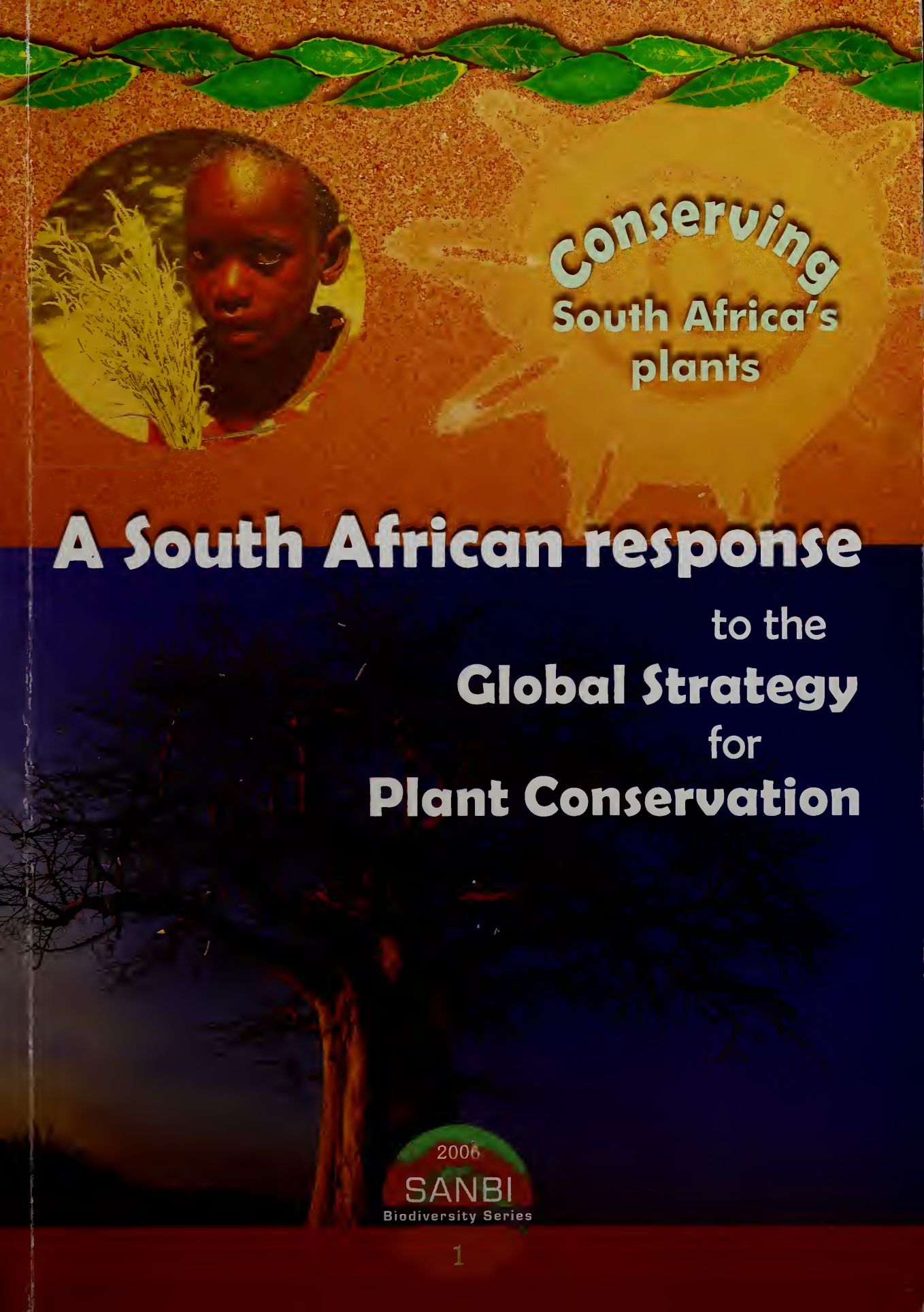


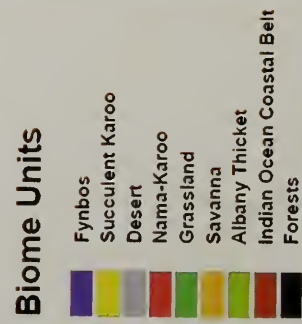


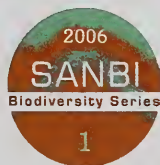
Conserving
South Africa's
plants

A South African response
to the
Global Strategy
for
Plant Conservation

2006
SANBI
Biodiversity Series

Biome Units of South Africa, Lesotho and Swaziland

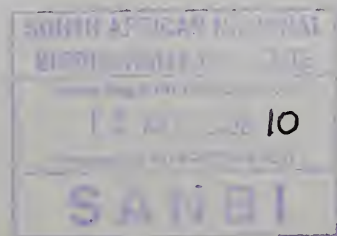




SANBI Biodiversity Series 1

Conserving South Africa's plants: a South African response to the Global Strategy for Plant Conservation

Editor: Christopher K. Willis



Pretoria

2006



SANBI Biodiversity Series

The South African National Biodiversity Institute (SANBI) was established on 1 September 2004 through the signing into force of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004 by President Thabo Mbeki. The Act expands the mandate of the former National Botanical Institute to include responsibilities relating to the full diversity of South Africa's fauna and flora, and builds on the internationally respected programmes in conservation, research, education and visitor services developed by the National Botanical Institute and its predecessors over the past century.

The vision of SANBI is to be the leading institution in biodiversity science in Africa, facilitating conservation, sustainable use of living resources, and human well-being.

SANBI's mission is to promote the sustainable use, conservation, appreciation and enjoyment of the exceptionally rich biodiversity of South Africa, for the benefit of all people.

SANBI Biodiversity Series will publish occasional reports on projects, technologies, workshops, symposia and other activities initiated by or executed in partnership with SANBI.

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Message of support



Peter S. Wyse Jackson

It was a great pleasure for me to be invited to contribute a message of support for this new publication, presenting a status report on South Africa's response to the Global Strategy for Plant Conservation (GSPC). I was particularly pleased to see South Africa continuing to play such an important leadership role in plant conservation in this regard, providing not only a valuable tool for use in South Africa but making available a model for similar reviews elsewhere in the world. It is one of the first national status reports on GSPC implementation that have been prepared to date. I hope that many more countries will follow this lead.

With almost 22 000 plant taxa indigenous to South Africa, representing a very significant proportion of the world's total flora, the conservation of this plant diversity is both an enormous challenge and significant national responsibility. It is well recognised that the indigenous plant diversity represents the greatest source of renewable natural resources of any country. Plants not only provide the basis for all terrestrial ecosystems but the goods and services they make available are the basis for most economies. As noted in the Plan of Implementation adopted by the world community at the World Summit on Sustainable Development held in Johannesburg in 2000, sustainable development and biodiversity conservation are inextricably linked and one cannot be achieved without the other. As this reports shows, this is clearly the case in South Africa where, for example, 3 500 plant species are used for medicinal purposes by some 200 000 traditional healers and where over 1.2 million visitors, including many tourists, come to see the plant collections of the National Botanical Gardens each year.

Close co-operation between a variety of organisations, institutions and individuals was a key component of the development of the Global Strategy for Plant Conservation from when it was first mooted in 2000 to its adoption on 19 April 2002 at the 6th Conference of the Parties to the Convention on Biological Diversity (CBD) in The Hague. Such collaboration, building on and maximising the synergies between widely different sectors and stakeholders, became an intrinsic part of the achievement of the Strategy. Although adopted at international level through the CBD, the achievement of the Strategy and its objectives clearly will only be possible through efforts made at national and local levels. It is therefore most welcome to see that the spirit of co-operation and recognition of the need for the widest possible stakeholder involvement in plant conservation in South Africa is a strand that runs throughout this publication.

The South African National Biodiversity Institute (SANBI) was one of the founding members of the Global Partnership for Plant Conservation (GPPC), established in 2004 to support the worldwide implementation of the Strategy. An important element of the work of the Partnership is to assist national efforts in plant conservation, helping to share experiences, technical know-how and resources and to stimulate the growth of partnerships and networks for plant conservation worldwide. It is apparent from this publication that South Africa has already made very significant progress towards the consolidation of a broad-based national network for plant conservation and in the development of national priorities and targets for plant conservation. I have no doubt that this publication will be of considerable assistance in highlighting achievements already made, as well as noting gaps and areas where progress has so far been limited. I hope that it will also play an important role in suggesting new directions and priorities for the future in helping to define where particular upcoming responsibilities may lie.

South Africa is a country with a great wealth of internationally recognised plant icons, such as the habitats and plants of the fynbos of the Cape Floristic Region, the Succulent Karoo and the Maputaland-Pondoland regions, as well as a multitude of unique proteas, cycads, restios, ericas, succulents and a diversity of other native species. The GSPC, with its 16 global targets for plant conservation, to be achieved by 2010, presents a significant challenge for South Africa. The difficulties in safeguarding such an important component of the world's biodiversity heritage will be momentous and cannot be underestimated. Continued and indeed enhanced support given by government and the international community will be crucial. So too will be participation from an increasingly concerned public. However, the practical actions carried out by the growing dedicated and determined community of people involved in plant conservation in South Africa will be vital to turn the strategies and objectives so well expressed in this publication into a reality throughout the country. Your efforts are applauded and deserve our sincerest congratulations and thanks. You have our full support for the future of these endeavours.

A handwritten signature in dark ink, reading 'Peter Wyse Jackson'. The signature is fluid and cursive, with the first name 'Peter' being more prominent.

Peter S. Wyse Jackson
Chairman
Global Partnership for Plant Conservation

9 February 2006
Dublin

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Foreword



Pam Yako

South Africa has, during the decade since its first democratic elections, made innovative advances in mainstreaming biodiversity within the diverse sectors of the country's economy. Recent developments around biodiversity and related actions and partnerships within South Africa indicate a willingness on the part of the South African government at all three levels—national, provincial and local—as well as of local and international donors, to commit appropriate resources to the conservation of biodiversity and ensure that people benefit directly and indirectly from this uniquely rich floral and faunal heritage.

One of the key developments that have taken place in the recent past has been the transformation of the National Botanical Institute (NBI) into the South African National Biodiversity Institute (SANBI). This followed the promulgation of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004. This expanded new mandate has meant a widening of the scope of SANBI into broader biodiversity responsibilities relating to the full diversity of the country's fauna and flora, while maintaining its national network of eight National Botanical Gardens, as well as its taxonomic and ecological research programmes and the management of its three herbaria. Part of this broader mandate includes reporting on the status and dynamics of South Africa's biodiversity and facilitating co-operative programmes between individuals, organisations and government departments. Such catalytic actions ensure efficiencies in research and knowledge management and access, in implementation of management best practice, and in advising the three tiers of government in areas that require specialist input.

This publication reflects the contribution that SANBI, through its network of partners, has made within the Global Strategy for Plant Conservation, an initiative endorsed by the Convention on Biological Diversity, of which South Africa has been an active signatory since 1995.

A stylized, handwritten signature in black ink, appearing to read 'Pam Yako'.

Pam Yako
Director General
Department of Environmental Affairs and Tourism
South Africa

10 February 2006
Pretoria

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Christopher K. Willis
Editor

10 February 2006
Pretoria

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Introduction

The Global Strategy for Plant Conservation (GSPC) was developed through extensive international collaboration and consultation and adopted unanimously and approved in Decision VI/9 of the sixth meeting of the Conference of Parties (CoP) to the Convention on Biological Diversity (CBD) held in The Hague on 19 April 2002. The ultimate and long-term objective of the Strategy is to halt the current and continuing loss of plant diversity. To achieve this and its secondary goals, the Strategy is divided into 16 outcome-orientated global targets intended for completion by the year 2010. The date of 2010 was used to synchronise the Strategy with the CBD's Strategic Plan. Of the 16 targets, four are regarded as cross-cutting targets to be considered in relation to the achievement of each other target. The cross-cutting targets in the GSPC are Targets 3 (conservation protocols and/or techniques), 14 (communication, education and public awareness), 15 (training/capacity building) and 16 (conservation networks).

This is the first time that such targets have been adopted under the CBD, and 'the success of this approach will be watched with interest as a potential model for other work programmes' (Hamdallah Zedan; Executive Secretary of the CBD). The Strategy addresses the Plant Kingdom, with focus on higher plants and other well-described groups such as bryophytes and pteridophytes. Parties may, however, choose on a national basis to include lower taxa.

The targets are structured under five main objectives, namely:

1. Understanding and documenting plant diversity	(Targets 1–3)
2. Conserving plant diversity	(Targets 4–10)
3. Using plant diversity sustainably	(Targets 11–13)
4. Promoting education and awareness about plant diversity	(Target 14)
5. Building capacity for the conservation of plant diversity	(Targets 15 and 16)

Subtargets and milestones under each target are currently being developed through an international stakeholder consultation process. While the targets set out in the Strategy are global targets, flexibility at a national and/or regional level has been built into the framework. National governments have been invited to adopt their own targets within the framework of the Strategy. These targets may vary from country to country, according to national priorities and capacities, taking into account differences in plant diversity between countries. According to Decision VI/9 of CoP6, parties and governments are invited to develop national and/or regional targets and, as appropriate, to incorporate them into relevant plans, programmes and initiatives, including national biodiversity strategies and action plans (NBSAPs).

The Strategy provides a framework to facilitate harmony between existing initiatives aimed at plant conservation, to identify gaps where new initiatives are required, and to promote mobilisation of the necessary resources. While the entry point for the Strategy is plant conservation, aspects of sustainable use, capacity building and benefit-sharing are also included. The Conference



Aframontane forests occur as scattered patches of vegetation along the escarpment, eastern seaboard and southern coast of South Africa.

Photograph: Christopher K. Willis



Baobabs, the world's largest succulents, form a dominant feature in the arid savannas of the northern parts of the Limpopo Province, South Africa.

Photograph: Christopher K. Willis



South Africa has a range of diverse landscapes and spectacular natural features, such as this waterfall outside Nieuwoudtville in the Northern Cape.

Photograph: Christopher K. Willis

of Parties has encouraged parties to nominate focal points for the Strategy, or designate from among existing focal points, to promote and facilitate implementation and monitoring of the Strategy at the national level, and facilitate participation of, and communication among, national stakeholders.

In an attempt to bring together international, regional and national organisations and agencies supporting and working towards the implementation of the GSPC, a Global Partnership for Plant Conservation (GPPC) was established at the seventh meeting of the Conference of Parties to the Convention on Biological Diversity in Kuala Lumpur, Malaysia, in February 2004. The partnership consists of member organisations, institutions, secretariats and other bodies that have substantial programmes in plant conservation and endorse the objectives of the GPPC. The partnership has no existing legal status but represents a voluntary commitment by participating organisations (the South African National Biodiversity Institute (SANBI) is one of the 20 founding members) to a common cause, the GSPC, who have agreed to come together in the framework of a GPPC to support the implementation of the GSPC. An important role of the partnership will be to enhance communication and collaboration among members. The priority will be to minimise duplication of effort and maximise available limited resources and ensure clarity in communication, such as approaches to donor agencies.

As signatory to the CBD (ratified on 2 November 1995), South Africa has committed itself to the implementation of the Global Strategy for Plant Conservation and has been closely involved in the development of the GSPC targets, mainly through participation in international meetings and workshops leading up to the adoption of the GSPC by the CoP in The Hague, Netherlands, in 2002. The institution that has done most work in relation to plant conservation in South Africa is SANBI and its predecessor, the National Botanical Institute (NBI), a parastatal organisation falling under the national Department of Environmental Affairs and Tourism (DEAT). Strongly supported by and in close partnership with the Botanical Society of South Africa, a national nongovernmental organisation established with Kirstenbosch in 1913, SANBI has contributed significantly towards an improved understanding and conservation of South Africa's plant diversity. While South Africa has not as yet developed specific national targets linked to the GSPC, many programmes and projects have contributed towards the conservation of plants in the country.

South Africa's floral wealth

South Africa is internationally renowned for its floristic diversity and high percentage of plant endemism. Some 21 721 plant taxa have so far been recorded as being indigenous to South Africa, including 862 bryophytes (mosses and liverworts) and 279 pteridophytes (ferns). More than half (13 192 taxa) of South Africa's indigenous plants are considered endemic, being restricted entirely to the country and found nowhere else in the world. The number of plant taxa recorded for South Africa is not static and continues to change, mainly as a result of new discoveries and taxonomic/systematic research. In the 10-year period between 1994 and 2004, more than 268 new species of South African plants were described by research staff attached to SANBI's three herbaria in Cape Town, Pretoria and Durban.

South Africa as a country contains a wealth of different habitat types, biomes and vegetation types. In addition to the Fynbos Biome, the biomes include Savanna woodlands (including a small patch of *Brachystegia*-domi-



While baobabs (*Adansonia digitata*) (top) have resisted damage caused by elephants (above) for thousands of years, management intervention in protected areas is required to prevent major transformation of savanna landscapes and habitats by these megaherbivores.

Photographs: Christopher K. Willis (top) and Humphrey C. Willis (above)



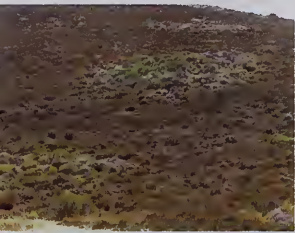
The largest block of continuous indigenous forest in South Africa is situated around Knysna on the southern coast of the Western Cape.

Photograph: Christopher K. Willis



The continued survival of many South African plants is dependent on insects and other pollinators.

Photograph: Christopher K. Willis



Heuweltjies ('little hills') or mima-like mounds are widespread in the Succulent Karoo Region. Usually of zoogenic origin, *heuweltjies* generally support taller, denser vegetation with a higher woody or succulent component than surrounding shrublands.

Photograph: Christopher K. Willis



The Cape Peninsula mountain chain (which includes Table Mountain National Park and Kirstenbosch National Botanical Garden) with 2 285 indigenous species and 161 endemic plant taxa, has the greatest concentration of plant species (per unit area) within the Cape Floristic Region. Table Mountain National Park and Kirstenbosch form part of South Africa's sixth World Heritage Site.

Photograph: SANBI

nated *miombo* woodland in the northeastern part of the country), Grasslands, afro-montane and coastal Forests, Succulent Karoo (with the highest species richness recorded for semi-arid vegetation and about 50% of the plant species endemic to the biome), Nama-Karoo, the Albany Thicket Biome as well as coastal and marine vegetation (including mangroves), and some unique wetland areas. Recent research has considerably refined the list of vegetation types of South Africa, with 440 vegetation types now having been mapped for the country. Studies of South Africa's areas of high plant diversity and endemism have revealed that the country comprises three regions (the Cape Floristic Region, Succulent Karoo Region and the Maputaland-Pondoland Region) and 15 centres of floristic endemism, each with its own combination of plant diversity, endemism and threats.

The Cape Floristic Region and the Succulent Karoo Region are floristically unique for different reasons. The Cape Floristic Region represents one of the world's six floral kingdoms and is the only floral kingdom entirely restricted to one country, South Africa. The Succulent Karoo is an area of exceptional succulent wealth, containing nearly half of the world's known succulent plant species. Both of these areas are considered in more detail below. In addition, the importance and extent of use of medicinal and useful plants by South Africa's diverse cultures deserves special mention.

Cape Floristic Region

The Cape Floristic Region (CFR), one of the world's six floral kingdoms, is entirely contained in an area of 90 000 km² (0.04% of the earth's land surface) within the southwestern corner of the country. The CFR—regarded as one of the world's 'hottest' hotspots—contains some 8 550 species of vascular plants, of which nearly 70% are endemic to the region. The CFR, an area of the country receiving winter rainfall (April to September) and with a mild Mediterranean-type climate, is dominated by fynbos (fine-leaved bush), a sclerophyllous, heath-like shrubland associated with nutrient-poor soils that cover most of the region. Fynbos is characterised by the combined presence of proteas, ericas and restios, as well as some buchus, pelargoniums, gladioli and sedges. While it is largely confined to the winter-rainfall CFR, fynbos also occurs in isolated patches along South Africa's eastern escarpment and northern mountain ranges, extending sporadically into subtropical and tropical Africa.

The CFR represents the richest concentration of bulbous plants anywhere in the world, being home to 60% of southern African bulbous plants, most of which grow nowhere else. Three families, the amaryllis, hyacinth and iris families (Amaryllidaceae, Hyacinthaceae and Iridaceae), account for nearly 90% of the bulbous species in the CFR. The Cape bulb flora is also renowned for the many striking and unusual growth forms, such as plants with tightly coiled leaves and leaves pressed to the ground.

Recent statistics on the flora of the Cape Peninsula mountain chain south of Cape Town have shown that in an area of 471 km², about 2 285 plant species are known to be indigenous. The Peninsula therefore has the greatest concentration of plant species (per unit area) within the CFR, with 161 plant taxa endemic to the area. The CFR became South Africa's sixth World Heritage Site in 2004. Classified as a serial site, the CFR World Heritage Site comprises eight protected areas covering 553 000 ha. Kirstenbosch National Botanical Garden, as part of the Table Mountain National Park, was included in the World Heritage Site, the first botanical garden in the world

to be included within a natural World Heritage Site.

Succulents

South Africa is world-renowned for the diversity of its indigenous succulent (plants with fleshy leaves, stems and/or roots) plants. Of the world's estimated 10 000 succulents, almost half are found naturally in South Africa, and most of them are endemic. Succulents vary in size, from the massive baobab tree (*Adansonia digitata*) to the miniature portulaca (*Portulaca rhodesiana*). The highest concentration of succulents is found in the Succulent Karoo Region (SKR), a semi-arid area subject to winter rainfall, where plants of the families Aizoaceae, Asclepiadaceae and Crassulaceae are especially well represented. The SKR is considered one of the earth's 'hotspots' and is the world's only entirely arid hotspot. The large succulent diversity in South Africa has been attributed to a combination of many factors, including a diverse climate, complex geology and topography contributing to diverse habitats, the long history of aridity in the country, and the occurrence of succulents from two distinct floral kingdoms, the temperate Cape flora in the south and the Palaeotropical flora in the north.

Medicinal and useful plants

Indigenous plants make a significant contribution to primary health care in South Africa. About 3 500 species of plants are known to be used as medicines and of these, about 350 species are the most commonly used and traded medicinal plants. There are an estimated 200 000 indigenous traditional healers in South Africa and up to 80% of South Africans consult these healers, usually in addition to using modern biomedical services.

South Africa's contribution to world medicine and health products includes Cape aloes (*Aloe ferox*), buchu (Aga-

Mountains in the sea: South Africa's sub-Antarctic islands

South Africa annexed and took possession of the Prince Edward Islands (comprising Marion Island and the smaller Prince Edward Island located at 46°S and 37°E), situated in the 'roaring forties' in the Southern Indian Ocean and located about 1 770 km southeast of Port Elizabeth, in December 1947. A meteorological/scientific station was established on Marion Island in 1948. Since that time, regular expeditions comprising scientists from several disciplines, conducting a wide range of research including biology, geology, geomorphology, and physics, have visited the islands, based mainly at the station on Marion Island. Since the first biological and geological expedition to the islands in 1965, over 800 scientific publications have been produced in addition to many popular articles, films and videos.

The Prince Edward Islands, estimated to be between 500 000 and 1 million years old, are protected as a Special Nature Reserve, and comprise a southern, sub-Antarctic flora of which most of the plants are cryptogams—mosses, liverworts and lichens. Because of the islands' isolation and low temperatures, plant diversity is lower than would be expected for a similar area on the South African mainland. Some 187 species of flowering plants, ferns, lichens, mosses and liverworts have been recorded on the islands, nine of which are endemic. A further 34 are not found outside the South Indian Ocean province. The most abundant flowering plants are the cushion-forming *Azorella selago* (Apiaceae), grasses, particularly tussock grasses, and sedges. The various plant communities and associations are based on altitude, exposure, water availability and the influences of salt spray and manuring by animals. The 41 plant communities on the islands are divided into seven complexes, namely the coastal salt-spray, fellfield, slope, biotic grassland, biotic herbfield, mire and polar desert complexes. Twenty alien vascular plant species have been introduced to the islands, of which 15 have become established. Conservationists have expressed concern that climatic changes on the islands (an increase of 1.5°C in the mean annual temperature has been recorded since the 1950s and the rainfall has declined by 25% to 30% in the same period) are speeding up the reproduction of invasive species. During a recent audit of invasive alien species on the islands, it was found that the invasive *Sagina procumbens* had tripled its distribution on Prince Edward Island since it was first discovered there seven years previously. Grass species in particular are expected to thrive under the warmer, drier conditions associated with the changing climate.



Marion Island in the Southern Indian Ocean. Photograph: Brent J. Sinclair

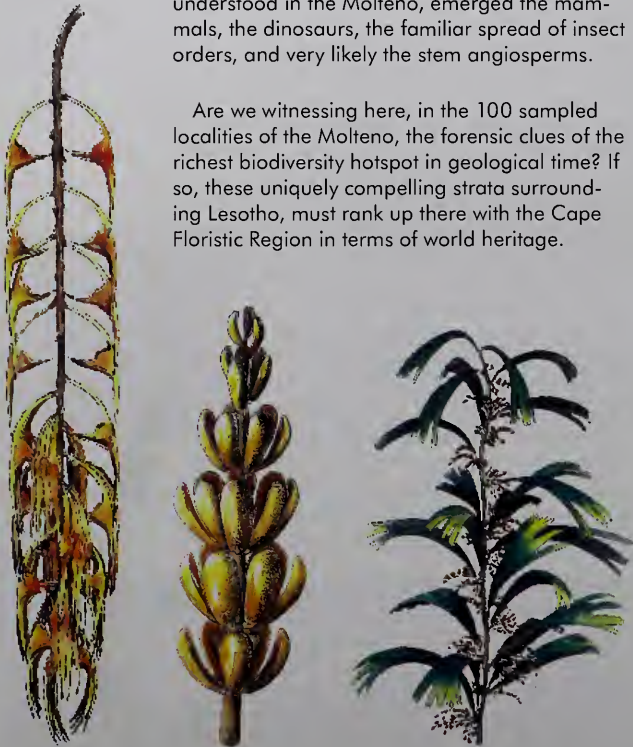
The Molteno Formation: heyday of gymnosperm biodiversity

John M. Anderson

If the Cape Floristic Region represents the prolific centre of angiosperm biodiversity at their heyday, so the Molteno Formation, outcropping in the spectacular landscape at the heart of South Africa, represents the most extravagant known expression of gymnosperm diversity at their heyday.

But there is something singularly different between these peaks of angiosperm and gymnosperm richness. Where the extant angiosperms are recognised as all falling within a single class, the highly depleted relict group of living gymnosperms are spread across four classes (the conifers, cycads, ginkgos and gnetaleans). Going back 225 million years to the Late Triassic, the unparalleled spectrum of morphology preserved in the fruit of the Molteno suggests no less than 10 classes of gymnosperm. The later Triassic must rank as one of the most extraordinary moments in Earth's history. Terrestrial life was all but obliterated in the end-Permian global extinction 250 million years ago. In the explosive radiation of new life that followed through the Triassic, the rules of traditional Darwinian evolution seem to have been bizarrely stretched. And in this radiation, in the ecosystems most fully understood in the Molteno, emerged the mammals, the dinosaurs, the familiar spread of insect orders, and very likely the stem angiosperms.

Are we witnessing here, in the 100 sampled localities of the Molteno, the forensic clues of the richest biodiversity hotspot in geological time? If so, these uniquely compelling strata surrounding Lesotho, must rank up there with the Cape Floristic Region in terms of world heritage.



Reconstructions of *Dordrechtites elongatus* (pinopsid), *Fredlindio fontifruetus* (bennettitopsid) and *Konnoskoppio vincularis* (possible stem-angiosperm) from the Molteno Formation. These fossil 'fruits' represent three newly described orders of gymnosperm in three distinct classes and provide a sense of the prolific biodiversity preserved in these strata.

Source: Anderson & Anderson (2003)

thosma betulina), bitterghaap (*Hoodia gordonii*), and devil's claw (*Harpagophytum procumbens*).

In addition to medicines, plants in South Africa are used for many other purposes. Some are used as foods, for example cereals, seeds, nuts, vegetables, roots, bulbs and tubers, fruits and berries, or drinks such as rooibos tea (*Aspalathus linearis*), honeybush tea (*Cyclopia intermedia*) and palm wine prepared from the ilala palm (*Hyphaene coriacea*) or the Mokola palm (*Hyphaene petersiana*). The fruit pulp of the marula (*Sclerocarya birrea* subsp. *caffra*) is used to flavour the well-known Amarula liqueur and commercial marula beer. Various plants are valued for beauty products such as perfumes, soaps, cosmetics and repellents that can be made from them. Other uses include items for hunting and fishing, dyes and tans, utility timbers, fire-making and firewood, and crafts such as basketry, weaving and ropes, thatching, mats and brooms. While some literature is available on the most common and interesting traditional uses of plants amongst South Africa's diverse cultures, the knowledge of indigenous plant use in the region needs urgent scientific documentation before it is lost to future generations.

Research and documentation

South Africa has a proud history of research and documentation of the country's floral wealth, reflected in the numerous scientific research papers, popular publications and field guides available within the country. This research includes studies on plant-animal interactions, taxonomy/systematics, physiology, pollination, invasive alien organisms and ecology.

Disturbance is an important component of all ecosystems and variations in disturbance regimes are known to affect ecosystem and community structure and functioning. The role of disturbances such as fire, grazing, storms, floods, soil disturbances, nutri-

National symbols



Plants are also represented in South Africa's national symbols. The protea features as the country's national flower (king protea: *Protea cynaroides*) and is also represented on the national coat of arms. The protea on the coat of arms represents the beauty of the country, the aesthetic harmony of the country's cultures, and the flowering of South Africa's potential as a nation in pursuit of the African Renaissance. The broad-leaved yellowwood (*Podocarpus latifolius*) is South Africa's national tree and has been recorded in coastal and montane forests stretching from Table Mountain in the south to the northernmost mountains of the Limpopo Province.

ent inputs, trampling, fragmentation, invasive alien organisms and the interaction between disturbances has been central to much of the plant ecological research conducted in various parts of South Africa during the past 25 years. Institutions such as SANBI, the Leslie Hill Institute of Plant Conservation, various universities, national government departments and provincial conservation agencies have all played key roles in documenting and understanding interactions and determinants in specific South African ecosystems.

Protected areas

South Africa has a range of protected areas, from national parks, provincial nature reserves, game reserves and biosphere reserves to private nature reserves, natural heritage sites and conservancies. While plant diversity information is available for some protected areas, much of this botanical information, particularly reserve checklists and university theses,

Mangroves and underwater forests

Habitats often neglected in South African plant conservation efforts include those associated with mangrove swamps and the marine algae. Mangroves are trees or shrubs that grow in bays and estuaries along the subtropical Eastern Cape and KwaZulu-Natal coasts, exhibiting their own zonation in response to tidal inundation. The most abundant mangrove tree species in South Africa include

Avicennia marina (white mangrove; with vertical, unbranched aerial roots or pneumatophores), *Bruguiera gymnorhiza* (black mangrove; buttress roots with 'knee roots'), *Ceriops togol* (Indian mangrove; buttress roots), *Lumnitzera racemosa* (Tonga mangrove; buttress or prop roots) and *Rhizophora mucronata* (red mangrove; prop roots or stilt roots arching widely from the trunk or branches). Mangrove trees develop only between the high-water mark of the spring tide and a point close to mean sea level. Epiphytic and bluegreen algae (cyanobacteria) form a significant component of the mangrove community. Mangrove and estuarine communities are sensitive to human disturbance, particularly engineering works (harbours, bridge construction and land development), domestic and industrial pollution, and unfavourable agricultural practices. More importance should be given in South Africa's conservation efforts towards the protection of sensitive coastal areas such as dunes and estuarine systems.

South Africa's marine vegetation, comprising seaweeds of mainly brown (Phaeophyta), green (Chlorophyta) and red (Rhodophyta) algae, has been well described by Bolton & Anderson (1997). South Africa's coastline includes three marine provinces (the Benguela Province, Agulhas Province and the Indo-West Pacific Province) and two overlapping areas (the Western Overlap between Cape Town and Agulhas, and the Eastern Overlap between East London and Durban). Red algae are the dominant group in each of South Africa's three marine provinces. Kelps (particularly the hollow-stiped 'sea bamboo' *Ecklonia maxima*) dominate the subtidal ecosystems (to depths of around 8 m) in much of the Benguela Province, wherever there are rocky substrata in the shallow sublittoral. Between 8 and 14 m depths, kelp beds are dominated by populations of the smaller kelp *Laminaria pallida*. Levels of endemism vary across the different algal groups. Of the almost 400 species on the South African west coast, Bolton & Anderson (1997) have indicated that 58% of the red algae, 33% of the browns and 28% of the greens are endemic to southern Africa.

In South Africa, two genera of seaweeds or agarophytes, *Gelidium* and *Gracilaria*, are collected commercially and used to provide agar used in the food and pharmaceutical industries. *Gelidium* is harvested annually in the Agulhas Province and Eastern Overlap, whereas *Gracilaria* occurs in economic quantities in Saldanha Bay on South Africa's west coast. According to Bolton & Anderson (1997), Saldanha Bay is the best mariculture site on the South African coast and careful environmental management of this protected embayment will be required in future. Small quantities of the southern African kelps (*Ecklonia maxima* and *Laminaria pallida*) are used locally in fertilisers and soil stabilisers.

The conservation of seaweed vegetation in South Africa is a difficult and little-studied topic, and there are enormous gaps in our understanding of South Africa's marine vegetation. Historically, most of the seaweed research has been concentrated in the southwestern Cape and there is still enormous scope for research on South Africa's seaweed communities and populations. Conserving seaweed diversity would best be carried out by the maintenance of marine reserves covering the variety of habitats of marine organisms in the different marine provinces and overlapping areas.



Mangroves extend along South Africa's eastern seaboard from the Kosi system in the north to the Nohoon River in the south. The vertical aerial 'pencil roots' or pneumatophores characteristic of *Avicennia marina*, one of the more common trees in South Africa's mangrove swamps, are shown here.

Photograph: Christopher K. Willis

Threats to South Africa's plants vary depending on the area of the country. Using the centres of plant diversity and endemism classification of Van Wyk & Smith (2001), they can be summarised as follows:	
Regions and centres of plant endemism	Threats to indigenous plants (from Van Wyk & Smith 2001)
1. Cape Floristic Region	Agriculture, alien invader plants, urban expansion, mining and quarrying activities, poor grazing practices and the commercial and illegal collecting of plant material
1.1 Kamiesberg Centre	Overgrazing, planting of wheat
2. Succulent Karoo Region	Overgrazing
2.1 Gariep Centre	Strip mining for diamonds, overgrazing by sheep and goats, alien plant invaders, illegal removal of succulents by collectors
2.2 Knersvlakte Centre	Overstocking with sheep, illegal plant collecting, irrigation schemes, gypsum mining
2.3 Little Karoo Centre	Crop farming, overstocking with sheep and ostriches
2.4 Worcester-Robertson Karoo Centre	Agricultural development (vineyards for the production of wine and table grapes), alien invasive plants, urbanisation, mining
2.5 Hantam-Roggeveld Centre	Overgrazing by domestic livestock
3. Maputaland-Pondoland Region	Population pressure, commercial timber plantations, agriculture, urban and industrial development, dune mining, invasive alien plants
3.1 Maputaland Centre	Commercial afforestation, clearing of land for agricultural purposes
3.2 Pondoland Centre	Inappropriate grazing practices, excessive burning and destructive agricultural activities (mainly commercial afforestation and growing of sugar cane)
4. Albany Centre	Rapid urbanisation, industrial development, land clearing for agricultural crops, commercial afforestation, poor grazing management and spread of alien plants
5. Drakensberg Alpine Centre	Overstocking of domestic animals, crop farming, plant collecting
6. Barberton Centre	Commercial afforestation, bush encroachment (due to lack of fire in plantation areas), mining
7. Wolkberg Centre	Commercial afforestation, alien invasive plants, lack of frequent fires in grasslands
8. Sekhukhuneland Centre	Overgrazing by domestic livestock, population pressure, mining activities
9. Soutpansberg Centre	Agriculture, commercial timber plantations, invasive alien weeds, bush encroachment, overgrazing
10. Griqualand West Centre	Bush encroachment, overgrazing by domestic livestock

remains unpublished and largely inaccessible. Much work has to be done in South Africa to achieve reliable or even preliminary baseline statistics as to which of our threatened plant species are conserved *in situ*. This need creates the opportunity for productive partnerships and collaboration between professional and amateur botanists, conservation authorities and societies (such as the Succulent Society and the Botanical Society of South Africa). Protected areas, while serving an important purpose for the *in situ* conservation of South Africa's indigenous plants, were not always established in representative areas of botanical diversity and endemism, and information on the botanical diversity present in these areas is often not available, with further botanical exploration and research activities required.

Climate change

An often neglected, but increasingly important area of research globally is the impact of climate change on ecosystems and plant diversity. As signatory to the United Nations Framework Convention on Climate Change (UNFCCC), South Africa has contributed significantly to the global research efforts on climate change. South African scientists are involved in ongoing research on the possible impacts of climate change on the survival and distribution of South Africa's indigenous plants. The South African Country Study on Climate Change investigated the effects of climate change on various indigenous plant species in detail and on the South African biomes in general. Predictions for future plant distributions in South Africa based on climatic factors, suggest some significant changes to the current situation.

Role players in plant conservation

Many people contribute towards plant conservation in South Africa. Involvement ranges from national government departments, such as the De-

Predicted changes to South Africa's biomes based on various climate models (from Midgley *et al.* 2001)

South African Biome	Predicted changes according to climate models (from Midgley <i>et al.</i> 2001)
Succulent Karoo	Within 50–100 years, areas that support Succulent Karoo vegetation today will become so arid that only the hardiest plants of that biome will be able to survive. Plants from the Desert Biome may colonise these areas, creating new plant communities not previously recorded.
Grassland	Woody plants may be able to invade grasslands, transforming them into savannas. Higher levels of carbon dioxide in the atmosphere will stimulate the growth of trees and shrubs.
Nama-Karoo	Will become drier and more desert-like, particularly in the west. Only in parts of the eastern Karoo will the climate still suit the vegetation of the Nama-Karoo Biome.
Fynbos	The northern arm of the Fynbos Biome may disappear altogether and many of the more drought-sensitive plants will be lost. As the biome has many endemics with narrow ranges, loss of range will result in extinctions. Mountains may provide essential habitats where plants can survive as they retreat to higher, cooler altitudes. Coastal fynbos may experience less extreme changes due to the moderating effect of the ocean. Some fynbos plants may go extinct through exposure to too frequent fires, and through disruptions to essential animal-plant relationships. The problem of alien invasive plants could be exacerbated through carbon dioxide encouraging the growth of woody plants.
Savanna	There may be a major rearrangement of plant species from the various savanna vegetation types in South Africa. Some species may disappear altogether, while the distribution ranges of others may shrink or expand. Trees and shrubs of the Savanna Biome may start encroaching on what is currently the Grassland Biome. The mopane tree (<i>Colophospermum mopane</i>) is predicted to extend its range substantially into the Limpopo Province and Mpumalanga lowveld. Miombo woodlands (dominated by <i>Brachystegia spiciformis</i>) could expand into the Limpopo Province and Mpumalanga.



Sani Pass in the southern Drakensberg, KwaZulu-Natal. The Drakensberg is a grass-covered massif with summits reaching altitudes of 3 000 m. The grassland is maintained by fire and grazing.

Photograph: Christopher K. Willis



Research on climate change in South Africa predicts significant changes to various biomes within the next 50 to 100 years.



Floating-leaved water lilies (species of *Nymphaea*) are common in many farm dams and freshwater wetlands in South Africa.

Photograph: Christopher K. Willis



Devil's claw (*Harpagophytum procumbens*) under cultivation. The plant is traded worldwide, has a reputation for efficacy in osteoarthritis, fibrositis and rheumatism and is particularly effective in small joint disease.

Photograph: Ben-Erik van Wyk. From: *People's plants—a guide to useful plants of southern Africa*, by Ben-Erik van Wyk & Nigel Gericke, published by Brizo Publications, www.brizo.co.za

partment of Environmental Affairs and Tourism (DEAT), Department of Water Affairs and Forestry (DWAF), Department of Science and Technology (DST), the national Department of Agriculture (NDA), through to provincial and local government departments. In addition, various parastatal organisations and nongovernmental and community-based organisations also contribute significantly to the conservation of South Africa's plants and associated habitats.

South Africa is one of the few countries in the world where a single institution, SANBI, manages a network of several national botanical gardens (NBGs) and research centres. Kirstenbosch National Botanical Garden (est. 1913 on the eastern slopes of Table Mountain) was the first national botanical garden to be established in South Africa. It focused entirely on the conservation and display of South Africa's wealth of indigenous plants and the network has subsequently grown to incorporate eight national botanical gardens, spread across five of South Africa's nine provinces. As embassies of biodiversity and culture, South Africa's NBGs attract over 1.2 million visitors per annum, with Kirstenbosch receiving over 750 000 visitors annually. Participants at the International Botanical Congress of 1999 voted Kirstenbosch as one of the 'Magnificent Seven' top gardens in the world.

Since 1913, plant conservation efforts in South Africa have been both initiated and supported by the Botanical Society of South Africa, a non-governmental organisation whose mission is 'to win the hearts, minds and material support of individuals and organizations, wherever they may be, for the conservation, cultivation, study and wise use of the indigenous flora and vegetation of southern Africa'. The Society has 16 branches spread across the country and produces a regular flagship newsletter, *Veld & Flora* (known from 1915 to 1974 as the *Journal of the Botanical Society of South Africa*), that showcases to its members the Society's involvement in plant conservation and education activities countrywide and features stories and horticultural notes on southern Africa's indigenous plants and their uses. Local branch members of the Society act as the 'friends' of South Africa's NBGs and support both *ex situ* and *in situ* plant conservation efforts. The Kogelberg Branch of the Botanical Society recently celebrated their 510th 'hack' (removing invasive alien plants from areas in and around Betty's Bay in the Western Cape), showing exceptional commitment from volunteers for the past 10 years. Since 1981, the Society has been publishing regional wild flower field guides to the indigenous flora of South Africa, and has sold over 100 000 copies to date.

Amateur botanists and associated societies have played and continue to play significant roles in promoting the conservation and public awareness of South Africa's indigenous plants. Their involvement includes the publication of wild flower and field guides, establishment of plant specialist groups (such as the Mpumalanga Plant Specialist Group), and serving as tour guides. Amateur botanists also produce *Plantlife*, a nonprofit journal with voluntary staff and contributors produced for everyone, particularly amateur botanists and indigenous plant growers, concerned about the conservation of South Africa's indigenous flora. *Plantlife* provides a forum for communication amongst lay people and bridges the gap between them and the professional world by making known the needs and interests of both groups.

Botanical artists also contribute and sell botanical art in support of plant conservation, often showcased in various publications and at both international and national art exhibitions, such as the biennial Kirstenbosch Biennale, with co-ordination provided by the Botanical Artists Association of Southern Africa. Various public awareness programmes in South Africa, such as national Arbor Week, have contributed significantly towards promoting a

greater awareness of the country's plant diversity and associated threats. A description of some of the many public awareness programmes for plants in South Africa has been included in Target 14 of this publication.

This publication, although not comprehensive, aims to provide a status report on the implementation of the GSPC in South Africa, highlighting some of the achievements towards the 16 targets as well as listing some of the challenges facing the country in attempting to implement the GSPC and its associated targets leading up to 2010.

The following information is given for each target:

- **Scope**—provides an overview of the scope and extent of the specific target
- **Achievements**—provides a broad overview of what has been achieved within South Africa towards the implementation of the specific target to date
- **Looking to the future**—provides a summary of the actions that have to be taken and the challenges facing South Africa in its attempts to achieve the target by 2010.

To facilitate the reading of individual target contributions, most literature references, listed per target, are included in a dedicated section entitled *References and Further Reading*. It includes literature referred to by the individual authors as well as additional sources that readers may find useful.

The overwhelming message is that greater resources have to be invested in co-ordinating plant conservation efforts at various levels within the country. Involvement in the implementation of the GSPC in South Africa also has to be broadened to involve as many people as possible, all working towards a common goal—the conservation of South Africa's plant diversity, one of the richest in the world. Challenging but realistic targets have to be set at the national level, and mechanisms for reporting, monitoring and evaluating progress also have to be put in place.



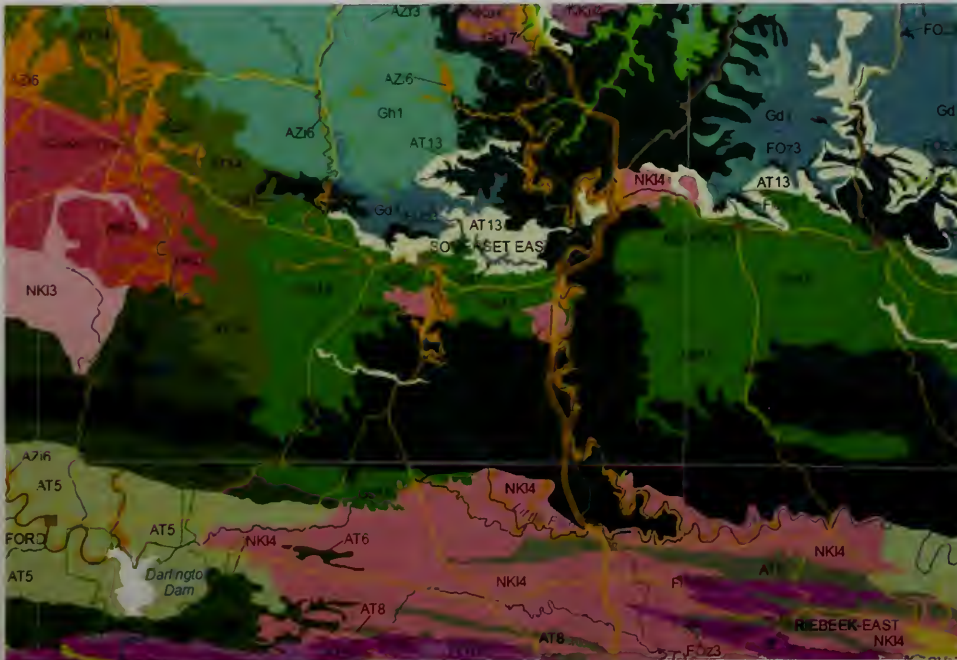
Commercial harvesting of the Cope pond weed or waterblammetjie (*Aponogeton distachyas*), an indigenous aquatic plant that is mainly popular as a vegetable in the Cape. The flowers are traditionally used in a stew or bredie.

Photograph: Nigel Gericke. From: *People's plants—a guide to useful plants of southern Africa*, by Ben-Erik van Wyk & Nigel Gericke, published by Brizo Publications, www.brizo.co.za



The Succulent Karoo Region, with a high concentration of low to dwarf leaf-succulent shrubs, represents the only entirely arid hotspot in the world.

Photograph: Christopher K. Willis



Eastern Cope oreo showing some of the detailed vegetation types contained in the new 1:1 000 000 scale Vegetation Map of South Africa, Lesotho and Swaziland by Mucino et al. (2005).

OBJECTIVE 1: Understanding and documenting plant diversity

Catalogues of South African plant life: documenting diversity for the benefit of all

Target 1:

A widely accessible working list of known plant species, as a step towards a complete world flora

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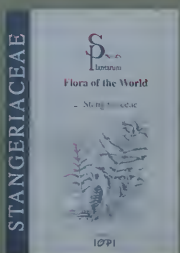
Scope

Arguably the very first step in establishing a Plant Conservation and Management Strategy for any region is the compilation of a comprehensive inventory of the plants that occur there. Such an inventory necessarily serves as the backbone and master checklist against which the conservation status of the taxa can be reflected. Understandably therefore, the first target of the Global Strategy for Plant Conservation (GSPC) is aimed at providing a workable checklist of the flora of the world. It is also intended that such a list should additionally serve as a first step towards the production of a world Flora.

Achievements

Through the efforts of successive generations of systematists employed in the three herbaria of the South African National Biodiversity Institute (SANBI), considerable progress has been made with creating accessible and accurate lists of the plants of the region. At the time of compiling the first of several approximations of the southern African checklist in the mid-1980s, it became evident that the richness of the southern African flora would be best appreciated once such a checklist was available.

The history of the compilation of a comprehensive species (and lower taxa) list for southern Africa dates back about 20 years when PRECIS (National Herbarium (PRE) Computerised Information System), the most important of SANBI's corporate databases, was used to generate a list for the so-called *Flora of southern Africa* region. This region includes Namibia, Botswana, Swaziland, Lesotho and South Africa. As comprehensive as possible a list of all the taxa was published as a complete record of the flora of the region. This pioneering book was followed by a second edition published in two parts. The first part, published in 1985, provided a list of the monocotyledons, cryptogams and gymnosperms and the second part, published in 1987, provided a list of the dicotyledons. The production of an update of this list was initiated almost immediately and by 1993, the next version of the southern African plant inventory was published. Ten years later, in 2003, the centenary year of the National Herbarium of SANBI, the most recent publication of this inventory became available. The publication of this tome of over 1 200 pages was necessary as the previous volume had long been out of print and



was considerably out of date. It also afforded the taxonomists of SANBI a good opportunity to add new distributional and biological information as a way of strengthening and enriching the list of names and thereby making it even more useful to a range of stakeholders.

Apart from the comprehensive continental, regional and in-country checklists, systematists of SANBI have produced a range of plant inventories in response to the needs expressed by many of the varied stakeholders and users of botanical information. Some of these are highlighted below while a more comprehensive list is given in Table 1.

Succulents of southern Africa

A comprehensive checklist of succulents of southern Africa was produced in 1997. This project was launched as a joint corporate activity between the then NBI and the Succulent Society of South Africa, and resulted in the publication of the definitive succulent plant checklist for the entire southern Africa. The outcome of this survey was astonishing: the region contains 4 674 succulent plants in 58 families and 350 genera! Following the production of the checklist, a world Flora for succulents was published by Springer-Verlag, through collaboration of an international consortium of succulent plant taxonomists. This multivolume project, the *Illustrated handbook of succulent plants*, was co-ordinated by Dr Urs Eggli at the Zürich Sukkulenten-Sammlung, Switzerland. It included treatments on most southern African succulent plant families by some of the world's leading specialists working on these plants, including several specialists from SANBI.

Medicinal plants of southern Africa

The flora of southern Africa has a rich and long history of traditional use. As part of the efforts to document and disseminate nonsensitive information on the uses of the plants of the subcontinent, SANBI published a comprehensive survey of plant use in 2002. This publication is especially significant since South Africa is a signatory to the Convention on Biological Diversity, which has the '...equitable sharing of benefits...' derived from the use of biodiversity as one of its cornerstones.

Aquatic plants of southern Africa

Wetlands are one of the most threatened habitats in southern Africa. These areas are easily viewed by the uninformed as watery wastelands, while they are in fact productive 'sponges' that absorb and release water to maintain ecological services downstream. Sadly, many wetlands have been badly managed in the past, resulting in their contamination with aggressive, alien invasive species, among other things. To provide the most basic management tool, SANBI is in the process of upgrading the published list of southern African aquatic plants to the level of an informative, abbreviated Flora.

It is therefore clear that considerable progress has been made with Target 1 of the GSPC, given that several significant checklists, including specialist treatments for some components of the richest temperate flora in the world, are now available.

The second part of Target 1 of the GSPC (producing checklists) as a *step towards a complete world Flora* has also received attention in South Africa. SANBI has co-provided the leadership and drive to initiate the Species Plantarum-Flora of the World Programme (SPPFW), including hosting one of its early Steering Committee meetings and chairing the Steering Committee for the past several years. Through active participation, South African taxonomists have contributed several volumes to the series of published SPPFW

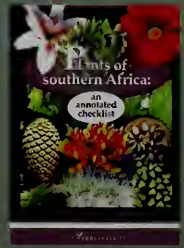
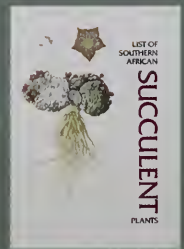
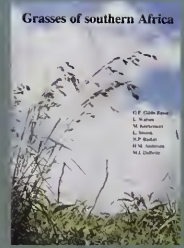


TABLE 1.—A collection of published South African plant inventories and checklists

Plant diversity component	Authors	Publication date
Poisonous plants	Phillips, E.P.	1926
Fungi and lichens	Doidge, E.M.	1950
Common names	Smith, C.A.	1966
Bryophytes	Magill, R.E. & Schelpe, E.A.	1979
Bryophytes, pteridophytes, gymnosperms and angiosperms	Gibbs Russell, G.E., Germishuizen, G., Herman, P., Olivier, P., Perold, S.M., Reid, G., Retief, E., Smook, L., Van Rooy, J., Welman, W.G.	1984
Green, brown and red algae	Seagrief, S.C.	1984
Cryptogams, gymnosperms and monocotyledons	Gibbs Russell, G.E., Reid, C., Van Rooy, J. & Smook, L.	1985
Problem plants	Wells, M.J., Balsinhas, A.A., Joffe, H., Engelbrecht, V.M., Harding, G. & Stirton, C.H.	1986
Dicotyledons	Gibbs Russell, G.E., Welman, W.G., Retief, E., Immelman, K.L., Germishuizen, G., Pienaar, B.J., Van Wyk, M. & Nicholas, A.	1987
Grasses	Gibbs Russell, G.E., Watson, L., Koekemoer, M., Smook, L., Barker, N.P., Anderson, H.M. & Dallwitz, M.J.	1990
Succulent plants	Smith, G.F., Van Jaarsveld, E.J., Arnold, T.H., Steffens, F.E., Dixon, R.D. & Retief, J.A.	1997
Aquatic plants	Glen, R., Archer, C. & Van Rooy, J.	1999
Medicinal plants	Arnold, T.H., Prentice, C.A., Hawker, L.C., Snyman, E.E., Tomalin, M., Crouch, N.R. & Pottas-Bircher, C.	2002
Cultivated plants	Glen, H.F.	2002

volumes, even though this emerging young initiative lacks the major funding investment it deserves.

Looking to the future

SANBI intends to increase the use of the electronic ether to disseminate as much as possible of its botanical information, and its catalogues are no exception. Therefore, Plants of Southern Africa (POSA) was launched in November 2005. This resource, which covers virtually all the information included in the hard copy version published in 2003, will be updated every two weeks to ensure that the latest high-quality information on the country's plants is available on the worldwide web free of charge.

But there is more. The first-ever exclusively South African plant checklist is in press, and will cover the basic biology of the 21 721 taxa that occur in the country. This catalogue will also include reference to taxa of restricted range, i.e. those that are endemic to South Africa.

At a different scale, SANBI and the Conservatoire et Jardin Botaniques de la Ville de Genève, Switzerland, have collaborated to compile a checklist of the flora of Africa south of the Sahara. This product, known as the APCD (African Plant Checklist and Database) is live and accessible on the internet, and will be published in the SABONET Report Series in 2006.

Although inventories become outdated quickly as new species are discovered and described, and progress is made with the refinement of existing taxonomies, they remain essential, basic research tools for conservation planners and other users of botanical information. Overhauling existing checklists is a time-consuming activity, but will remain a corporate endeavour undertaken by SANBI at regular intervals.

OBJECTIVE 1: Understanding and documenting plant diversity

Plants under threat: Red Data Lists to the rescue

Target 2:

A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels

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Scope

Given the enormous diversity and uniqueness of the flora of South Africa, it has been a long-standing objective of the country's conservation efforts to comprehensively assess the Red List status of our plants. This has been achieved in a series of ever-expanding approximations that will culminate in the publication in 2006 of the first-ever Red List assessment of all the plants that occur within the borders of the country.

Achievements

Ever since Red Data Lists (RDLs) became popular as useful conservation tools internationally, South Africa has been at the forefront of producing these first-order derivatives of primary plant inventories. The country therefore has a strong recent history of producing these useful lists.

Work on the first RDL for plants was initiated in the 1970s after the first fairly reliable predictions and extrapolations on the alarming levels of tropical forest depletion had been published. At the time the RDLs were strongly supported by the Council for Scientific and Industrial Research (CSIR) and in the 1980s its then Foundation for Research Development (FRD), through its *South African National Scientific Programmes Report* series, saw a massive output in this field for most of the biota of South Africa, ranging from plants (Hall *et al.* 1980) through to microfauna and terrestrial mammals. As could be expected, these works represented very good first approximations of information essentially aimed at informing the process of conserving and managing threatened taxa. Not surprisingly, the first generation of RDLs were very soon out of print, indicating that the end-users were finding them exceptionally useful. In the case of plants, herbarium records played an important role in predicting, and in some instances establishing, a reliable status of threat.

A geographically more restricted second round of refining the RDL for plants was produced by Hall & Veldhuis (1985) for the Cape and Karoo floras, and this publication was also soon out of print. Shortly thereafter, in 1989, the National Botanical Institute (NBI) of South Africa came into being, following the amalgamation of the National Botanic Gardens of South Africa and the Botanical Research Institute. Through the effective consolidation of these organisations, the stage was set for revitalising the well-established process of producing plant RDLs.



A succession of South African plant Red Data Books.

Numbers of globally threatened South African plant taxa listed in Red Data Lists produced in 1980 (Hall *et al.* 1980), 1996 (Hilton Taylor 1996), 2002 (Victor in Golding 2002) and 2005 (Threatened Species Programme interim list) are shown below. The 1980 assessments were conducted using unpublished assessment criteria defined by the IUCN; the 1996 assessments used criteria defined by Davis *et al.* (1986); 2002 assessors used IUCN version 2.4 (1994) criteria and the 2005 assessments are conducted according to IUCN version 3.1 (2001) criteria. Categories that were not used in particular versions of the criteria are marked *n/a*.

Category	1980	1996	2002 (25% of flora only)	2005 (inter- mediate list)
Extinct	39	56	15	48
Extinct in the Wild	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	7
Critically Endangered	<i>n/a</i>	<i>n/a</i>	19	175
Endangered	104	241	58	216
Vulnerable	165	422	322	814
Rare	521	1 322	<i>n/a</i>	<i>n/a</i>
Indeterminate	259	378	<i>n/a</i>	<i>n/a</i>
Insufficiently Known	805	849	<i>n/a</i>	<i>n/a</i>
Data Deficient	<i>n/a</i>	<i>n/a</i>	108	610
Near Threatened	<i>n/a</i>	<i>n/a</i>	92	413
Least Concern	<i>n/a</i>	<i>n/a</i>	334	16 187
TOTAL assessed	1 893	3 268	948	18 057
TOTAL threatened	790	1 985	399	1 205

Comparisons of trends in total numbers of threatened species in the various Red Data Lists can be misleading as changes in the criteria used for classification lead to gross inconsistencies between lists. For example, from 1994 (IUCN criteria version 2.4), plants defined as 'Rare' that did not have an area of occupancy of < 20 km² or five or fewer locations (the criteria qualifying them as Vulnerable) were reclassified as of 'Least Concern'. This is the main factor contributing to the drastic 'drop' in threatened species numbers after 1996 and highlights the need for stable Red List Criteria for the use of Red Lists in ongoing monitoring.

In 1996, only seven years after amalgamation, the NBI published a very good third approximation (Hilton-Taylor 1996), which nine years later (though not for much longer) is still the standard reference for checking the threatened status of the flora of southern Africa. At around the time when the NBI published this RDL, the criteria for allocating a threatened status (version 2.3) were extensively revised by the IUCN, making some of the older RDLs somewhat obsolete. The process of revising and refining the IUCN's global Red List assessment criteria took several years, but now appears to have stabilised as version 3.1.

As part of the process of co-financing some of the activities of the Southern African Botanical Diversity Network (SABONET), the Networking and Capacity Building programme for southern Africa (NETCAB) of the southern African office of the World Conservation Union (IUCN-ROSA) supported the production of an RDB for plants for all ten countries participating in the SABONET project. With the initiation, execution and completion of this project over the past few years, this first-ever subcontinental RDL (Golding 2002) for plants has again taken its rightful place on the shelves of all biologists, environmentalists and planners working in the region.

However, in the case of the rich and unique South African flora only 25% of plant taxa were assessed as part of the SABONET project. The Threatened Species Programme (TSP) was therefore established by SANBI to address the gaps that existed (Victor in Golding 2002), and to use the most recent set of criteria established by the IUCN (version 3.1) for allocating a threat status to the entire South African flora. This ambitious three-year project, funded by the Royal Norwegian Embassy and SANBI, is due to be completed in mid-2006 and will produce a comprehensive RDL in both book and online format, as well as products to guide policy-makers, decision-makers,

conservationists, environmental consultants and the public in dealing with threatened species, their habitats and processes threatening our flora. The programme has sponsored research on threatened plants by postgraduate students and consultants, and made a sizeable contribution to digitising and georeferencing specimens of rare and threatened plants in provincial and university herbaria.

A programme called Custodians of Rare and Endangered Wildflowers (CREW) forms an essential and novel part of the Threatened Species Programme. CREW trains underprivileged communities, farmers and other landowners in priority threatened-plant areas of the Western and southern Cape to monitor and conserve their own rare and threatened flora. This programme has been extremely successful during its first 2.5 years and eight groups of enthusiastic volunteers are now actively participating in conservation and the ongoing collection of invaluable data that are used directly for Red List assessments. CREW is currently being expanded into a national programme so that its novel and groundbreaking model can be initiated throughout South Africa.

As a prerequisite for conducting Red List assessments, accurate taxonomies reflecting the correct identity and circumscription of threatened taxa (see GSPC Target 1) are essential. This includes predictive classifications supported by user-friendly identification tools to ensure the adequate documentation of threatened taxa under Target 2 of the GSPC. Furthermore, it is vital that South African organisations continue to support ongoing field studies of our flora, in particular for rare, threatened and Data Deficient taxa, so that subsequent Red List assessments can provide accurate reflections of population declines, increases and changes in range. We are, however, concerned that the current Red List criteria do not adequately reflect the threat of anthropogenic climate change. We therefore call on the international community to find a practical method of including threats induced by climate change so that Red Data Lists continue to provide a comprehensive reflection of the overall risk of extinction of a species.

Looking to the Future

The more than 20 Red Listing initiatives that have been conducted on South Africa's various biota over the past 30 years have led to a wealth of experience in dealing with the practicalities and challenges involved in Red Listing. SANBI gathered a broad range of Red List producers and users together at a workshop in early 2005 to distil best practices and lessons learned from the experiences of our conservationists and Red List users. These are being compiled into a published report to help current and future projects, both in South Africa and other countries, to conduct such initiatives.

The newly re-established IUCN Southern African Plant Specialist Group, hosted by SANBI, plans to maintain and stimulate the fulfilment of GSPC Target 2 throughout the subcontinent. The main aim of the specialist group is to maintain the Red Listing programmes, expertise and enthusiasm generated by the now terminated SABONET programme through ongoing training, communication, collaboration and shared access to sources of funding. A particular focus is to encourage and support the production of regular Red List updates in other southern African countries. The IUCN Southern African Plant Specialist Group will also facilitate collaboration in the development of regional Red List assessments for species that are widely distributed and global assessments for species with a subcontinental distribution.



Vulnerable *Ramulea sabulosa* occurs at very few locations in the Northern Cape and is threatened by habitat destruction and invasive alien species. Photograph: Ismail Ebrahim



The Endangered *Aloe pillansii* is found only in the Richtersveld mountains of the Northern Cape and faces the threats of illegal harvesting for horticultural trade, mining and climate change.

Photograph: Christopher K. Willis

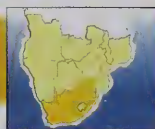


Community members of the Harmony Flats Working Group monitoring populations of threatened fynbos plants on the Cape Flats, Western Cape.

Photograph: SANBI

South Africa's past and present contributions to meeting national commitments to GSPC Target 2 have played a significant part in the global achievement of this target. Of the 11 521 higher plant assessments currently listed in the IUCN's Global Red List Assessment Database, only 129 are of South African origin (IUCN Red List of Threatened Species 2005) and the TSP's forthcoming contribution will almost triple the number of globally databased plant species. Through the above Red Listing initiatives, it is clear that SANBI has established itself as a world leader in compiling plant RDLs. The Institute will continue to play a pivotal role in producing updates of this indispensable source of information for the conservation of our magnificent flora.

South Africa



Janine E. Victor*

Introduction

To date, 3,268 species have been recorded as "threatened with extinction" in South Africa (Hilton-Taylor 1996a). This new Red Data List (RDL) is an attempt to provide updated assessments according to the 1994 IUCN system as a starting point from which progress can be made. It is important to realise that the list presented here is preliminary and can therefore only be used in conjunction with Hilton-Taylor (1996a, b, 1997) and should not be seen as a replacement. Only 949 (about 25%) of the taxa listed by Hilton-Taylor (1996a, b, 1997) have so far been updated. Where possible, whole families were completed, but in four cases (Aizoaceae, Apocynaceae, Aloaceae, and Asteraceae), only parts of the families are complete. Genera within these four families are, however, complete.

Since the main contributors to the RDL were systematists with research knowledge of their particular taxonomic groups, a taxonomic, rather than geographic, approach was adopted for the compilation of the RDL. Although it is incomplete, I hope that this RDL will show clear trends that will be similar to the final, complete RDL.

The *Red Data List of southern African plants* (Hilton-Taylor 1996a, b, 1997) lists provincial assessments (Cape, Orange Free State, Natal and Transvaal) for each geopolitical area, along with national and global RDL assessments. The assessments in this new list are at the national level, but are obviously also global assessments where taxa are endemic to South Africa. Provincial assessments are not provided in this account of the South African RDL, because of the artificial nature of demarcating natural areas according to political boundaries.

Methods

The approach taken towards producing a new RDL for South Africa within a limited

period was to elicit co-operation from as many people as possible. National workshops were held to give potential collaborators an overview of the methodology of the IUCN (1994) system of assessing conservation status. The anticipated outcome of these workshops was to equip people with the knowledge required to provide useful information for the RDL. After these training workshops, I undertook follow-up visits with individual collaborators so that the information could be consolidated.

The following procedures were conducted for each taxonomic group:

- The names of the taxa already assessed in each taxonomic group included in this list were obtained from the SARARES database, an electronic version of Hilton-Taylor (1996a, b, 1997). This database is a compilation of plant species on the RDL, their assessments and accompanying notes, and is available on the SABONET website (<http://www.sabonet.org/redatalist/database.html>).
- Nomenclatural updates were made. The most up-to-date scientifically correct names were provided by each specialist according to the latest revisions. These names match those used in the PRECIS database at the National Herbarium, Pretoria (PRE).
- Label information of all plant species collected in South Africa that are housed in PRE and stored in PRECIS provided distribution information to supplement data used in the assessments.
- Distributions were updated according to the new provincial boundaries.
- Additions (new or previously overlooked taxa) were incorporated.

Results and Discussion

A total of 948 taxa were assessed, of which 414 are threatened with extinction (Table 1). Most species fall into the *Vulnerable* (VU) category; some 270 of these (81%)

Capital: Pretoria (administrative capital), Cape Town (legislative capital)

Area: 1,220,088 km²

Languages: English, Xhosa, Zulu, Afrikaans, Ndebele, North Sotho, Sesotho, Swazi, Tsonga, Tswana, Venda (all official)

Currency: Rand

Total plant species: 23,420

Total plant endemics: no available information

Total RDL plants: 948

Focal RDL institutions: PRE

Number of Protected Areas: About 18 National Parks, including two Transfrontier Parks (Lesotho-South Africa and Mozambique-South Africa-Zimbabwe), numerous other protected areas, and several proposed protected areas (including Transfrontier Parks).

Population: 42,106,200 **Growth Rate:** 1.7% **Density:** 33.3 people/km²

Phytogeography: Cape in the south and southwest, Karoo-Namib in the west, Kalahari-Highveld Regional Transitional Zone in the centre, Zambezi elements in the north and east, Afromontane patches scattered in enclaves, and Tonga-Pondoland Regional Mosaic along the eastern coast.

Flora: Fynbos and its variants in the southwest, arid (Succulent Karoo) and semi-arid karoo shrubland and grassy shrubland in northern and central Cape, highveld grassland over much of the central plateau, open savanna woodland on the eastern plateau, montane forest and grasslands in enclaves, savanna and low-lying forest on the east coast.

Sources: Anonymous 2000, Cowling & Hilton-Taylor 1994, Low & Rebelo 1996

*National Herbarium, Pretoria, South Africa

OBJECTIVE 1: Understanding and documenting plant diversity

Providing models with protocols for plant conservation

Target 3:

Development of models with protocols for plant conservation and sustainable use, based on research and practical experience

Christopher K. Willis

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Scope

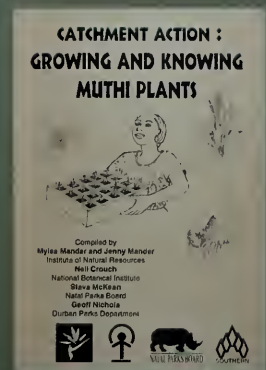
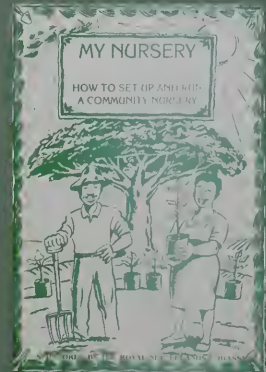
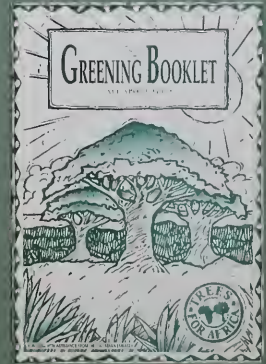
This target addresses the need for the development of models and protocols for applying best practice in the conservation of plant diversity and the sustainable use of its components. As one of the four cross-cutting targets, it is applicable to many of the other targets in the GSPC, each requiring slightly different methods and protocols. These models and protocols will be based on existing and new research and practical management experience. 'Protocols' are defined in the GSPC as practical guidance on how to conduct plant conservation and sustainable use activities in particular settings. Key areas where the development of models with protocols are required include (a) the integration of *in situ* and *ex situ* conservation, (b) maintenance of threatened plants within ecosystems, (c) applying the ecosystem approach, (d) balancing sustainable use with conservation, (e) methodologies for setting conservation priorities and (f) methodologies for monitoring conservation and sustainable use activities.

Achievements

Protocols for different aspects of plant conservation and sustainable use have been developed by individuals, both amateur and professional, in South Africa over several decades. Much of this information has, however, unfortunately not been co-ordinated, with the result that the information that could be used, lies scattered amongst both published and unpublished reports and manuscripts and is not readily accessible to conservation practitioners. In addition, results from applied research projects are too often not made available to those individuals responsible for on-the-ground conservation.

Much expertise exists within the southern African botanical community, among both amateurs and professionals, on methods of propagation and cultivation of southern Africa's threatened plants, although very little of this has been documented. Succulent plant enthusiasts have published several articles over the past two decades that relate to the propagation and cultivation of South Africa's succulent plants. The *Kirstenbosch Gardening Series*, prepared largely by horticulturists within the South African National Biodiversity Institute, has provided a useful example of how this information can be made available to the broader public, including conservation authorities.

Useful information is generated through research conducted by the Millennium Seed Bank Project (MSBP) in its collaboration with SANBI. Threatened Species Dossiers (TSDs) are prepared by researchers at the Millennium Seed Bank that contain information about plant populations in the wild, germination protocols, propagation methods and recommendations for the *in situ*



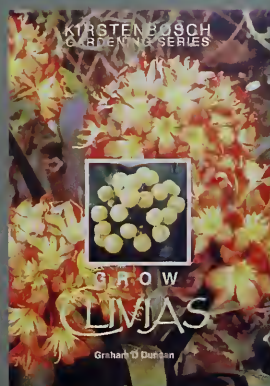
and *ex situ* conservation of the species. TSDs are given to local conservation authorities and managers in South Africa.

The web address www.plantzafrica.com, part of the SANBI website, provides a useful web-based information source on South Africa's indigenous plants (including uses, habitat, distribution, ecology, cultural aspects and propagation techniques), used extensively by researchers, learners and educators. The website includes a range of medicinal plant monographs made available to the public through collaboration between SANBI, the South African Medical Research Council and the University of the Western Cape. A recently published number in the SABONET Report Series entitled *Growing rare plants*, is a valuable handbook on propagating the threatened plants of southern Africa, sharing knowledge gained through years of experience of individual plant propagators.

Looking to the future

As this is a cross-cutting target within the GSPC, there is a need to capture, in a central database or through a national clearing house mechanism, the various methodologies and protocols that have been developed for plant conservation and sustainable use in South Africa, that are applicable to all the GSPC targets. The models that have been developed have to be widely disseminated and co-ordinated from a single, preferably web-based, information source. Much of the information that could be used lies either within university libraries, in offices or archives of development agencies or conservation authorities, or remains in the heads of individuals who have, for various reasons, not documented their knowledge and experience. There is a need to capture the inaccessible or remote information and make it available electronically to as broad an audience as possible. Another area that needs to be addressed, is the co-ordination of lessons learnt in the areas of plant conservation and sustainable use. Many conservation biology research and management projects often have mixed successes, and the documentation of lessons learnt could be useful in preventing future generations from having to 're-invent the wheel'.

Efforts also have to be made towards documenting propagation methods for the less charismatic southern African threatened plants. There is also a need to document *in situ* conservation methods and, in the few areas where this has been implemented in southern Africa, to integrate *ex situ* and *in situ* conservation methods.



Publications containing notes on cultivation and propagation of South Africa's indigenous and threatened plants.

OBJECTIVE 2: Conserving plant diversity

Achieving biodiversity conservation through on- and off-reserve mechanisms

Target 4:

At least 10 per cent of each of the world's ecological regions effectively conserved

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Scope

Conserving at least 10% of each of the world's ecological regions implies (i) increasing the representation of different ecological regions in protected areas, (ii) increasing the effectiveness of protected areas, and (iii) developing off-reserve conservation mechanisms. Even a conservation target of 10% might not be adequate for all ecological regions, especially for those with high species turnover or high levels of plant endemism.

Achievement

Currently, nearly 6% of South Africa is under protection. This includes statutory reserves (national parks, provincial and local authority nature reserves) and nonstatutory reserves (such as mountain catchment areas, private nature reserves) with a much less secure conservation agreement. The conservation estate consists of 465 statutory protected areas (representing 77% of the total protected area) and 471 nonstatutory protected areas. Only few protected areas are greater than 100 000 ha, most of them being between 1 000 and 10 000 ha. While concern has been raised that small protected areas might be inadequate for maintaining large-scale processes (such as natural fire regimes), they do play an important role in conserving some of the last remaining fragments of lowland vegetation types.

In assessing the protection levels of ecological regions, it is important to take into account the pattern of endemism and species turnover between regions. One way to address this issue is to set differential biodiversity targets (i.e. the minimum area that should be conserved) for each ecological region based on a species-area curve. Species-rich regions or those with a high species turnover receive a higher biodiversity target. It would also be ideal to include some measure of management effectiveness within protected areas. However, it is unlikely that we will ever have a national dataset that provides widely endorsed information of this kind. In the absence of information about management effectiveness, legal status and ownership must suffice as a way of distinguishing categories of protected areas.

As biodiversity and protected areas are not uniformly distributed in the landscape, huge gaps appear in the protected area network. In terms of biome representation, Forest, Fynbos and Desert are the most protected biomes (in terms of percentage of total area), while Nama-Karoo and Grassland are the least protected biomes. Ecological regions are hereby defined on the basis of major vegetation types. An assessment of the protection levels of each region reveals that, out of 45 ecological regions in South Africa, 11 have almost no form of protection at all, with less than 1% of their original



Mountain catchment areas, such as the Drakensberg along South Africa's eastern escarpment, serve as important refuges providing a variety of habitats for many plants and animals.

Photograph: Christopher K. Willis



Private nature reserves, such as the Buffelskloof Private Nature Reserve, form an important component of South Africa's protected areas network.

Photograph: Christopher K. Willis



Statutory reserves, such as Verlorenvallei Nature Reserve near Dullstroom in Mpumalanga, play important roles in conserving representative portions of South Africa's ecological regions.

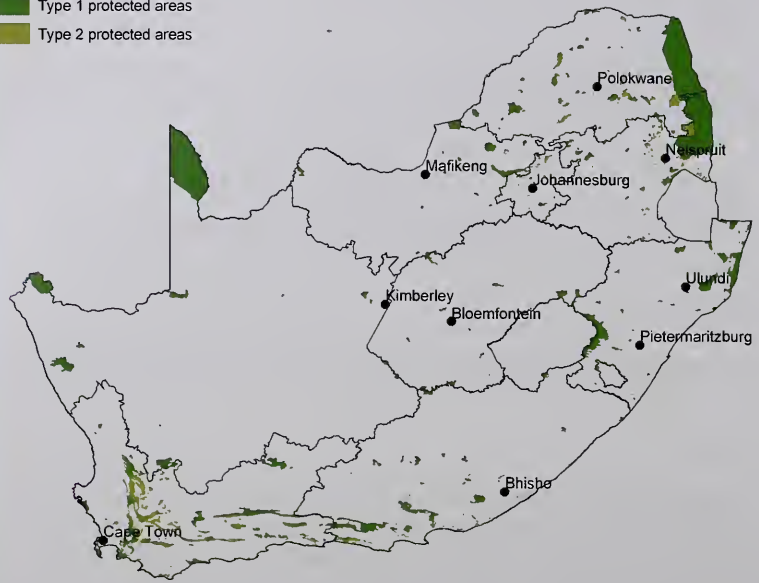
Photograph: Christopher K. Willis



The Nama-Karoo Biome is characterised by dwarf open shrubland and sustains an important meat- and wool-based small-stock industry. In terms of its ecology, the Nama-Karoo is one of the least studied of South Africa's biomes. It is also one of the least protected of the country's biomes.

Photograph: Christopher K. Willis

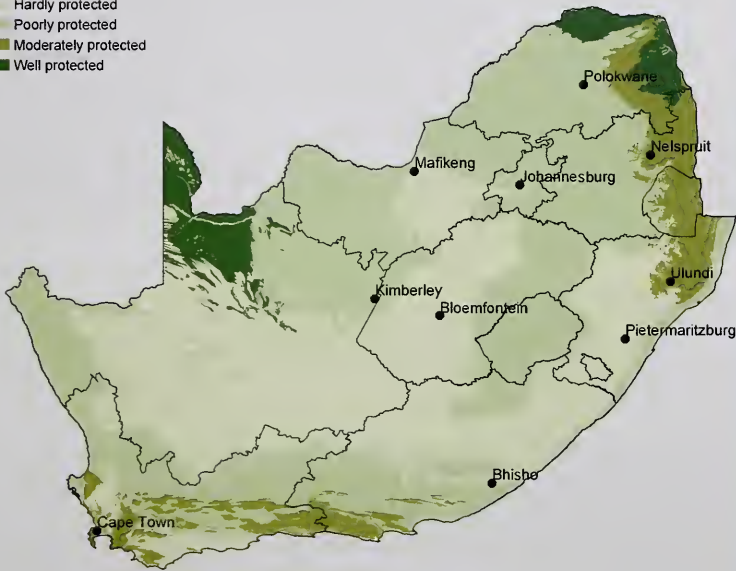
- Type 1 protected areas
- Type 2 protected areas



Protected area network in South Africa



- Hardly protected
- Poorly protected
- Moderately protected
- Well protected



Protection levels of ecological regions, based on the proportion of the biodiversity target met in Type 1 protected areas.

The fever tree (*Acacia xanthophloea*) is a common plant of the seasonally flooded areas of the Pangala floodplain in Nduma Game Reserve, northern KwaZulu-Natal. These trees were associated with malaria by early travellers before the cause of malaria was understood. The association arises from the fact that the tree grows in wet habitats that also form the breeding grounds of malaria-transmitting anopheline mosquitoes. Ndumo is one of the oldest parks in Africa and some 60% of South Africa's bird species have been recorded there.

Photograph: Kaas van der Lende





The Kgalagadi Transfrontier Park which straddles the border of South Africa and Botswana in the southern Kalahari Desert was the first formally declared transfrontier park in Africa. With a combined land area of about 38 000 km², this statutorily protected area represents one of the largest relatively undisturbed arid savannas in Africa. The vegetation of the Kalahari, comprising some 625 plant species, is predominantly grassland with a relatively depauperate Zambezian tree flora (mainly species of *Acacia*) growing an undulating red sand dunes.

Photograph: Steven R. Giddings

extent protected. Only 10 regions have 10% or more of their original extent protected. In relation to biodiversity targets set for each region, 13, with only less than 5% of their biodiversity target protected, are hardly protected. Forty regions have less than half of their biodiversity target conserved in statutory protected areas. The biodiversity targets of only two Savanna ecological regions, the Kalahari Duneveld and the Mopane regions, are met in statutory protected areas. This assessment focuses on representation of biodiversity pattern, and larger areas will be required for conserving critical ecological and evolutionary processes.

Looking into the future

To meet the biodiversity targets for all regions, at least an additional 215 000 km² would have to receive some form of conservation action. This amounts to 22% of the remaining natural habitat in South Africa.

Protection level can and should inform priorities for the establishment and expansion of protected areas. Based on the principle of representation, ecological regions not adequately represented in the current protected area network should receive priority attention. However, the establishment of formal protected areas is certainly not the only possible form of conservation action. Especially in regions that are highly fragmented, conservation action may include, for example, working with industry and local government to ensure conservation-friendly land use in priority areas.

The listing of threatened ecosystems allowed by the new Biodiversity Act could be a powerful tool for reducing habitat loss and thus reinforcing the conservation of threatened ecosystems. Used in conjunction, measures of ecosystem status and protection level are very useful for identifying priority regions in need of conservation action of some kind. Ecosystem status tells us which ecological regions are most threatened, while protection level tells us which regions are least protected. For example, it is clear that the East Coast and West Coast Renosterveld regions, which are critically endangered and not represented in the current protected areas network, have not received adequate conservation attention.

South Africa has embarked on an ambitious protected area expansion programme to address the gaps in terms of protection levels of ecological regions. This will also be supported by several bioregional programmes aiming at conserving South Africa's precious biodiversity through various mechanisms.

OBJECTIVE 2: Conserving plant diversity

Important Plant Areas (IPAs) in South Africa

Target 5:

Protection of 50 per cent of the most important areas for plant diversity assured

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Scope

Target 5 is concerned with protecting the most important areas for plant diversity according to criteria such as endemism, species richness and/or uniqueness of habitats. Protection of these sites should be assured through conservation practices, including an effective protected areas network.

Achievements

Important Plant Areas (IPAs) in South Africa

The concept of Important Plant Areas (IPAs) in southern Africa was initiated at a workshop hosted by the Southern African Botanical Diversity Network (SABONET) in South Africa in May 2004. The aim of the workshop was to discuss the initiation of Important Plant Areas in southern Africa and the relevance of the international criteria for selecting Important Plant Areas within a southern African context. As a result of this initial workshop, Namibia and Mozambique each hosted workshops on selecting national Important Plant Areas. In South Africa, a desktop study was done to identify Important Plant Area mapping regions using a numerical classification of PRECIS (National Herbarium (PRE) Computerised Information System) dataset quarter-degree square (QDS) herbarium records.

The identification of Important Plant Areas in South Africa was further discussed at an annual forum for biodiversity planners and the implementers of biodiversity planning projects held in 2005. It was agreed that these areas were important for raising awareness of plant conservation and could be a useful tool for implementation of biodiversity plans. South Africa is at the cutting edge of systematic conservation (biodiversity) planning and as such a number of successful tools already exist in the country for the identification of priority biodiversity areas. Although not formally identified as such, many of these areas are indeed Important Plant Areas.

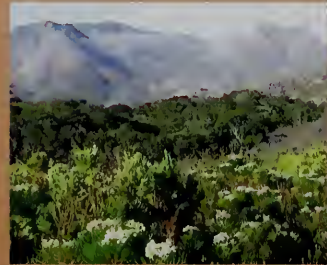
Systematic conservation (biodiversity) planning

In 2005, the South African National Biodiversity Institute (SANBI) and the national Department of Environmental Affairs and Tourism (DEAT) produced the first National Spatial Biodiversity Assessment (NSBA). This report is the first comprehensive spatial assessment of biodiversity throughout the country. It has four components, dealing with the terrestrial, freshwater, estuarine and marine environments. By integrating species distribution of over 10 000 endemics and/or threatened plants with information on habitats and ecological processes, the NSBA identified Important Plant Areas but also areas important for terrestrial ecosystems and/or ecosystem processes. The assessment resulted in the identification of nine broad priority areas in South Africa and



Mountains of the Moon. The Richtersveld includes some spectacular mountainous scenery within the Gariep Centre of the Succulent Karoo Region. The Gariep Centre is recognised as an important centre of plant diversity and endemism in Africa. Many of the plants in this area depend on moisture supplied by fog, known locally as the *malmokkie*, which occasionally moves in from the Atlantic Ocean during the night or in the early morning.

Photograph: Christopher K. Willis



The Kogelberg Biosphere Reserve, which includes the Kogelberg Mountains in the Western Cape, was the first internationally recognised biosphere reserve in South Africa. The Kogelberg Mountains, regarded as the heart of the Cape Floristic Region, are home to 1 650 plant species, 77 of which are endemic to the area. The Reserve serves as a model for private/public partnerships in implementing conservation management alongside development.

Photograph: Hans Heilgendorff

provides a valuable set of indicators, including ecosystem status and protection levels of ecosystems, to allow for the ongoing monitoring and reporting on the state of biodiversity in the country.

A number of provinces in South Africa have produced provincial biodiversity plans that identify irreplaceable, highly significant and important sites within the specific province. A number of fine-scale biodiversity plans have also been done at the local level. Most of these plans include species-level information. Many of the priority areas identified are in fact Important Plant Areas, for example the Knersvlakte in the Succulent Karoo and Sekhukhune-land in Mpumalanga Province.

Regions and centres of plant endemism

Regions and centres of plant endemism in southern Africa have been defined and discussed by Van Wyk & Smith in a book published in 2001. Three regions and 15 centres of plant endemism fall within South Africa and it has been suggested that many of the Important Plant Areas in South Africa fall within these regions and centres of plant endemism. Most of the regions and centres of plant endemism in South Africa fall within one of the bioregional programmes and will benefit from existing or planned conservation initiatives.

Bioregional programmes in South Africa

South Africa has a number of bioregional programmes, which are multi-sectoral partnership programmes in an ecoregion that aim to link biodiversity conservation with socio-economic development. These programmes involve implementation of biodiversity plans through projects with participating stakeholders. Four of these programmes are currently managed from within SANBI, namely the Cape Action for People and the Environment (C.A.P.E.), the Subtropical Thicket Ecosystem Programme (STEP), the Succulent Karoo Ecosystem Programme (SKEP) and the National Grasslands Biodiversity Programme. Other bioregional programmes in the country include the Maloti-Drakensberg Transfrontier Project (MDTP) and the Wild Coast Conservation and Sustainable Development Programme.

Custodians of Rare and Endangered Wildflowers (CREW)

SANBI started a programme called Custodians of Rare and Endangered Wildflowers (CREW) in 2004 to involve community groups living in Important Plant Areas in the conservation and monitoring of sites where threatened species occur. The programme had its first phase in the Cape Floristic Region (CFR) and has thus far worked in nine Important Plant Areas. CREW groups are actively involved in the conservation of 20 sites where threatened species are found. In all nine areas, groups spend time building awareness of sites where threatened plants grow by surveying sites and providing information on management requirements to specific landowners. Over 250 such sites have been surveyed and data provided to landowners. The decision to formally conserve these sites remains in the hands of the landowners, but a Stewardship Programme that promotes private land conservation in the CFR is currently being implemented, with 60 farms currently under negotiation to be conserved. As of 2006, the CREW programme is expanding to work in all nine biodiversity priority areas identified in the NBSAP.

Looking to the future

New legislation, such as the Biodiversity Act (10 of 2004) and the Protected Areas Act (57 of 2003), provide powerful tools for achieving management and conservation of biodiversity in South Africa. Chapter 4 of the Biodiversity Act allows for the listing of ecosystems and species that are threatened or

Blouberg is an important plant area within the North Eastern Mountain Escarpment, one of the nine priority areas for conservation action in South Africa. The Blouberg, which forms an 'island' in a sea of arid savanna, includes areas of afro-montane forest, grassland, savanna and fynbos. The mountain forms an important natural resource for surrounding communities.

Photograph: Christopher K. Willis



in need of protection and ensures that the utilisation of biodiversity is managed in an ecologically sustainable way. The Protected Areas Act allows for any land, private or communal, to be declared a formal protected area and allows for the co-management of such a protected area by the landowner(s) or any suitable person or organisation. This means that government agencies are not the only organisations that can manage protected areas.

Three key strategies were identified by the NSBA for conserving South Africa's biodiversity:

- Pursuing opportunities for linking biodiversity and socio-economic development in priority areas to mainstream biodiversity in production landscapes and seascapes.
- Focussing action on threatened ecosystems to prevent the further loss of ecosystem functioning.
- Expanding the formal protected areas network as the existing protected area network does not conserve a representative sample of South Africa's biodiversity.

Cape geophytes represent the richest concentration of bulbaus plants anywhere in the world and the centre of diversity of several of the larger bulbaus families. Below: Large pink inflorences of *Brunsvigia basmaniae* (Amaryllidaceae) flowering in autumn (March to May). Top: *Ferraria divaricata* (Iridaceae). Right: *Gladialus alatus* (Iridaceae). Photographs: John C. Manning



OBJECTIVE 2: Conserving plant diversity

Conserving plants within production lands

Target 6:

At least 30 per cent of production lands managed consistent with the conservation of plant diversity

Kristal Maze

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Scope

Production landscapes in South Africa comprise those areas used for agriculture (both cropping and grazing), plantation forestry and mining. These landscapes cover approximately 70% of the terrestrial landscape and harbour important areas for biodiversity at the species and ecosystem levels.

Given the geographic spread and extraordinary diversity of South Africa's plants, it is widely appreciated that it is simply not possible to conserve the majority of species through the traditional protected areas approach. To conserve this rich diversity, it is therefore necessary to mainstream biodiversity priorities into the policies, plans and programmes of a range of stakeholders whose core business is not biodiversity, but whose day-to-day activities significantly impact upon biodiversity. The need to engage with the production sectors is recognised as a key strategy in the country's recently published National Biodiversity Strategy and Action Plan (NBSAP) as well as several strategies at the bioregional scale.

The type of production activities vary in terms of their compatibility with conservation objectives and different strategies are required to address these. For example, in large parts of the Grassland and Succulent Karoo Biomes and subtropical thicket regions, livestock grazing activities are potentially compatible with biodiversity conservation objectives. In production landscapes where natural habitat transformation, through ploughing, for example, takes place, avoidance of key biodiversity sites is a key aim.

The NBSAP has developed several objectives and targets aimed at key production sectors and industries to encourage them to integrate biodiversity into their production and service standards. This particular NBSAP outcome requires the various sectors that impact on biodiversity to implement effective changes at an operational level. Changes at a macro-economic level, such as elimination of perverse incentives, or payment for ecosystem services, together with increased awareness of biodiversity considerations, effective enforcement of legislation, application of the principle of co-operative governance, etc., are also addressed in the NBSAP, and are needed to mainstream biodiversity into the key sectors. The relevant NBSAP objectives are as follows:

1. Include biodiversity considerations in guidelines and best practice codes of key agricultural industries, to mitigate negative impacts of agricultural production on biodiversity and encourage sustainable agricultural practices.
2. Include biodiversity considerations in forestry industry guidelines and best practice codes to mitigate negative impacts of commercial forests and

Grazing of cattle has been identified as one of the most compatible agricultural activities in the Grassland Biome.

Photograph: Christopher K. Willis

Sugar cane (*Saccharum officinarum*) poses a threat to coastal forests in the Maputaland-Pan-daland Region.

Photograph: Christopher K. Willis

Lowland areas of the Cape Floristic Region are threatened by, amongst others, agricultural development, particularly vineyards and wheat farming.

Photograph: Christopher K. Willis

harvesting of natural forests on biodiversity and encourage sustainable forestry practices.

3. Include biodiversity considerations in mining regulations and guidelines and best practice codes to mitigate negative impacts on biodiversity and encourage sustainable mining practices.

Achievements

Conservation Farming Project

From 1999 to 2003, the then National Botanical Institute co-ordinated the Conservation Farming Project, which was a targeted research programme supported by the Global Environment Facility (GEF) and the Mazda Wildlife Fund. The aims of the Conservation Farming Project were to:

- Assess the ecological and economic costs and benefits of various agricultural practices, including both conventional and conservation farming methods.
- Promote land use practices that conserve biodiversity and provide sustainable livelihoods for farmers and rural communities.

Some of the project focal areas included:

- Biodiversity: the benefits of increased biodiversity on farms for farmers and everyone else.
- Soils: how conservation farming improves soil structure and improves production.
- Ecosystem services: how healthy ecosystem processes provide services to all.
- Carbon sequestration: how to lower atmospheric carbon dioxide levels and so reduce global warming.
- Economic incentives: why it pays to have a healthy environment.
- Putting conservation farming into practice: getting farmers' views on conservation farming, and improving the flow of information to farmers.

Bioregional Programmes

Since 2000, South Africa has initiated four bioregional programmes in the Succulent Karoo Biome (Succulent Karoo Ecosystem Programme), Cape Floristic Region (Cape Action for People and the Environment: C.A.P.E.), subtropical thicket region (Subtropical Thicket Ecosystem Programme) and Grassland Biome. These programmes aim to address biodiversity conservation at the landscape scale taking into consideration socio-economic development issues. All four programmes are currently in the process of piloting approaches under each of the three NBSAP objectives mentioned above.

Examples of specific projects that are under way, include the following:

Livestock and game grazing in the grasslands

The Grassland Biome covers about 30% of South Africa's surface (339 238 km²). The wide environmental variation present in the highveld grassland gives rise to the presence of more than 3 370 plant species, including many herbaceous wildflowers and geophytic species (83% of the grassland species). The mean species richness of 82 species per 1 000 m² is second only to the Renosterveld vegetation community. According to the 1996 National Land Cover data, 64.5% of the biome is still natural land cover, with 22.4% cultivated. Some 59% of the country's beef cattle, 58% of the country's sheep and 75% of its dairy farming are found within the grasslands.



Clearing of land for flower cultivation in the Agulhas Region of the Cape Floristic Region can have damaging effects on the natural vegetation. Avoidance of key biodiversity sites during agricultural practices such as ploughing is a key factor in conserving plants within production lands.

Photograph: Christopher K. Willis



Conservation Farming Project leader, Dr John Donaldson, discussing project results with a group of farmers at a farmers' day in Nieuwoudtville, Northern Cape. Photograph: SANBI



Conservation Farming Project research scientist, Barney Kgope, measuring soil respiration rates on a farm near Kirkwood, Eastern Cape.

Photograph: A. Mills



The Conservation Farming Project showed that up to 80 tonnes of carbon is lost from each hectare of thick vegetation when it is transformed by goats (lower section).

Photograph: Conservation Farming Project



The creation and maintenance of buffer areas around natural forests is an important practice in the commercial forestry industry.

Photograph: Christopher K. Willis



At Flower Valley, an experiment is in progress to determine sustainable yields of wild-harvested flowers, coupled with the certification of socially and environmentally sustainable farm management practices.

Photograph: Kristal Maze



The Biodiversity and Wine Initiative seeks to influence environmental management within vineyards and in adjacent areas.

Many of the priority biodiversity sites fall within these agricultural landscapes. The programme seeks to identify and promote biodiversity-compatible land uses. Grazing of cattle, sheep and indigenous game species has been identified as the most compatible agricultural activities in the Grassland Biome. Market-related and other incentives will be investigated as means for promoting biodiversity-compatible land uses in the biome and these will be piloted during the implementation of this programme, which will run for five years commencing in 2007.

Facilitating sustainable agriculture in the Slanghoek Valley

The provincial Department of Agriculture in the Western Cape and farmers in the Slanghoek Valley, when faced with difficult decisions regarding development that would affect natural ecosystems, requested maps of biodiversity priorities. C.A.P.E., through the development of a small project funded by the Critical Ecosystem Partnership Fund (CEPF), was able to support the mapping of biodiversity priorities in the valley, to map the existing agricultural lands within the valley and to generate overlays of proposed development. This clearly indicated where proposed transformation would impact on priority biodiversity, and enabled the authorities to steer development towards less critical areas.

Of major importance was the degree of co-operation this engendered among authorities who often deal with conflicting priorities, enabling them to take a more strategic approach, and reinforcing this form of collaboration among these agencies in other areas of their jurisdiction.

Biodiversity and Wine Initiative

The location of the best agricultural soils for the cultivation of table wine grapes coincides with South Africa's most threatened lowland ecosystems. These lowland ecosystems harbour large numbers of threatened and endemic plant species. The challenge is to guide the expansion of vineyards in a way that avoids further transformation of priority biodiversity areas. The Biodiversity and Wine Initiative seeks to influence environmental management within vineyards and in adjacent areas. There are two main mechanisms, one involving the stewardship by estate managers of priority biodiversity resources on these lands, and the other involving the promulgation and adoption of industry-wide guidelines and standards for land management and wine production, avoiding such negative impacts as water abstraction and pollution through runoff of agri-chemicals. The industry has now incorporated the biodiversity guidelines into their Integrated Production of Wine guidelines and is exploring the potential marketing benefits of using the biodiversity of the Cape Floristic Region as a unique selling point for South African wine.

Sustainable harvesting of wild flowers

The harvesting of wild fynbos for international flower markets has been a traditional activity on the Agulhas Plain for decades. Changing land use practices and a highly seasonal market have impacted on farm viability, resulting in the sale of properties and the replacement of wild harvesting by other more lucrative, but damaging, land uses such as flower cultivation or viticulture. At Flower Valley, an experiment is in progress to determine sustainable yields of wild-harvested flowers, coupled with the certification of socially and environmentally sustainable farm management practices. Early results have been the development of niche markets for certified flower products, and the engagement of the private sector in developing viable year-round production and sales.

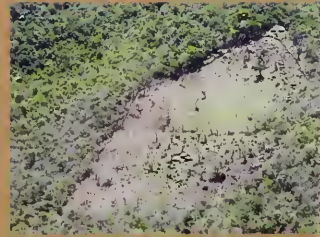
Biodiversity and mining

Mining is one of the key economic activities in the Succulent Karoo hotspot. The entire northern extension of the Succulent Karoo is mineral-rich, and, with various mining applications pending throughout the region, transformation by mining operations represents a significant pressure on biodiversity. Certain types of mining result in irreversible loss of natural habitat across large areas. Where mineral deposits are located in biodiversity-rich areas, it inevitably results in competing land use needs between mining and conservation. In most cases the conditions for mining approval have been weak and of little value from a biodiversity conservation point of view.

To address this, the SKEP programme is engaging proactively with the mining industry to improve the biodiversity management performance of existing as well as new operations through several means. A mining and biodiversity forum of corporate and small-scale mining enterprises is being established to discuss and develop mechanisms for addressing biodiversity concerns. With the support of the CEPF, the SKEP programme is also investing in pilot projects in Bushmanland as well as on the Namaqua Coast, aiming to incorporate mine-owned lands into multi-ownership protected area initiatives. The aim here is to encourage mines to contribute to conservation targets as well as regional development objectives. So far the programme has been successful in encouraging certain mining companies to see themselves as custodians of biodiversity rather than as threats to biodiversity, and to view themselves as positive contributors to conserving biodiversity in priority areas.

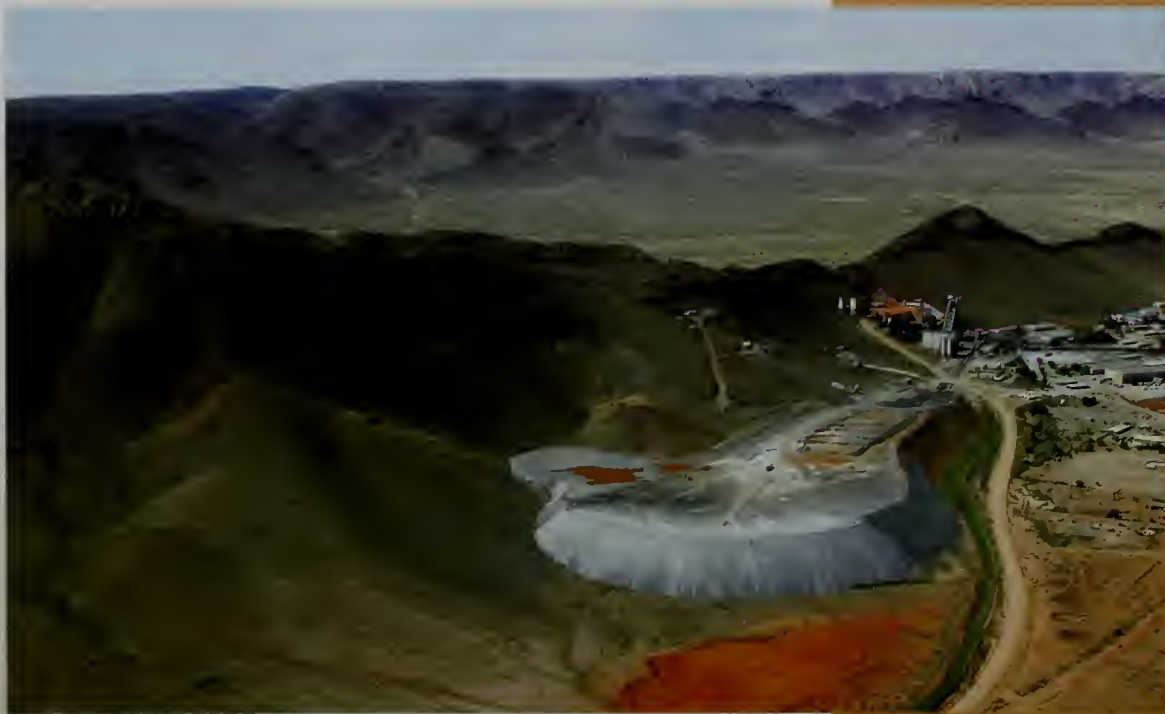
Looking to the future

Through its bioregional programmes, SANBI will continue to pilot and implement approaches that improve the practices of the production sectors. Further research into biodiversity-compatible land uses is also required.



Guidelines and best practice codes that include biodiversity have to be developed to guide practices such as clearing of natural vegetation for subsistence agriculture.

Photograph: Christopher K. Willis



Mining is a major economic activity in the Succulent Karoo Biodiversity Hotspot. Mining companies are being engaged in a proactive way through the SKEP bioregional programme and are being encouraged to improve their biodiversity practices. Photograph: Kristal Moze

OBJECTIVE 2: Conserving plant diversity

Conserving threatened plants *in situ*

Target 7:

60 per cent of the world's threatened species conserved *in situ*

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Scope

To be considered as conserved *in situ* in the context of this target, a species must be effectively maintained (a) in at least one protected area or (b) through other *in situ* management strategies. While a figure of 60 per cent of species has been set as the 2010 target, this should be seen as only a first step towards effective *in situ* conservation of all threatened species.

Achievements

South Africa's National Spatial Biodiversity Assessment (NSBA) made use of data on threatened and endemic plants and animals as one of the main factors determining the country's priority conservation areas. Priority threatened species sites were defined according to their irreplaceability, i.e. those that had either many species of special concern or at least one species of special concern found nowhere else. The nine broad priority sites that were identified for conservation action will be specifically targeted using three key strategies, namely (1) by pursuing opportunities to link biodiversity and socio-economic development in priority areas, (2) by focusing emergency action on threatened ecosystems to prevent further loss of ecosystem functioning, and (3) by expanding the formal protected area network.

The planning exercise used by Driver *et al.* (2005) for the NSBA was repeated for threatened and endemic plants alone, and all the priority threatened plant conservation areas identified in this way lie within nine broad priority areas for conservation action identified by the National Spatial Biodiversity Assessment. South Africa's priority threatened plant areas will therefore benefit greatly from the proposed conservation strategies in the NSBA, and the expansion of the protected area network in these areas will further our progress in achieving GSPC Target 7.

Due to the coarse scale of the distribution data of most of our plant species (generally only to quarter degree square resolution), it is not possible to determine the numbers of species represented in each protected area. As a result, we cannot calculate the percentage of our threatened flora conserved *in situ* in protected areas and are unable to give quantifiable progress on GSPC Target 7. To remedy this, the Threatened Species Programme is currently supporting the georeferencing of locality descriptions that appear on the labels of existing rare and threatened plant specimens in national, provincial and university herbaria. The programme is also focusing on the collection of new species locality information throughout the country through volunteer groups of the Custodians of Rare and Endangered Wildflowers.



Merwillia plumbea (Hyacinthaceae), recorded here in the South Eastern Escarpment priority conservation area, is an important medicinal plant in South Africa that is considered threatened largely due to over-harvesting in the wild. The plant is commonly taken in the form of decoctions and enemas as a purgative and for treating internal tumours.

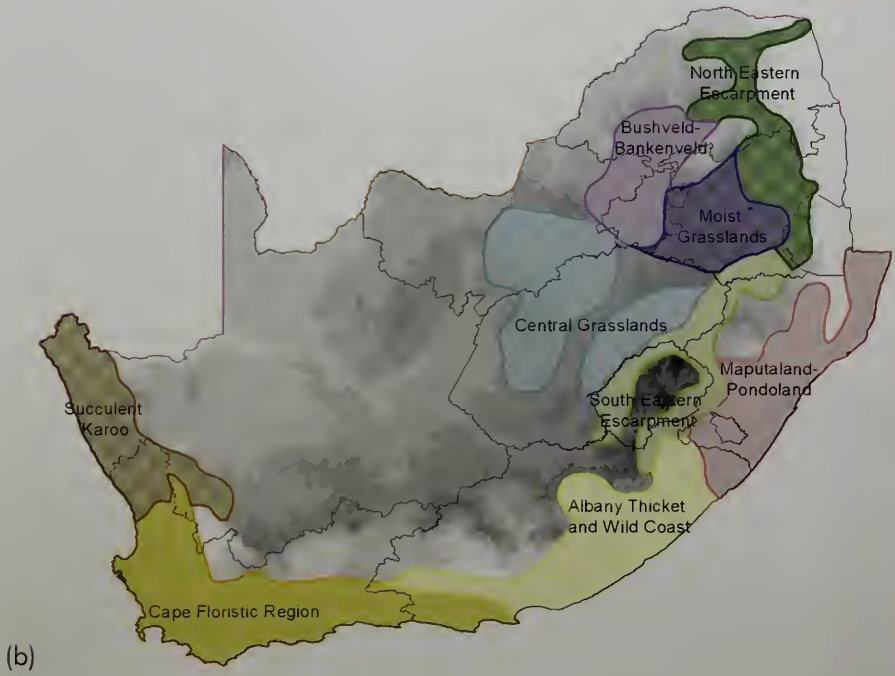
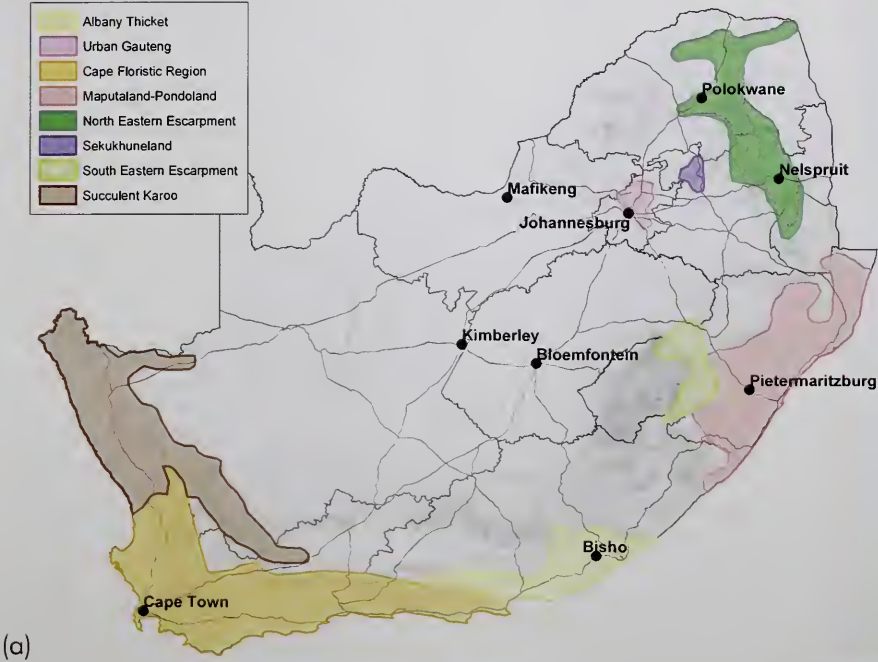
Photograph: Christopher K. Willis



Although succulents are not generally associated with fynbos vegetation, it does include a significant number of succulent endemics such as the dwarf shrubby mesemb *Braunsia vanrensborgii* (Mesembryanthemaceae), a threatened limestone endemic from the southern Cape.

Photograph: Christopher K. Willis



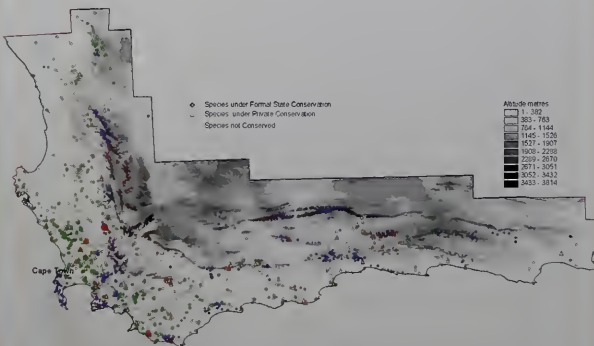


(a) Priority areas identified for conserving threatened plants. (b) The nine priority areas identified for the conservation of overall biodiversity by the National Spatial Biodiversity Assessment (Driver et al. 2005).

Case study: How many Cape Floristic Region threatened plants are protected?

While sufficiently fine-scale data are not available to determine the percentage of threatened plants occurring in protected areas across South Africa, such data are available for the Cape Floristic Region. We found that of the 790 threatened taxa represented in the region, 316 (40%) had at least one population occurring in a formal, state-owned conservation area, 108 taxa (14%) were conserved only in private conservation areas, and 366 (46%) did not occur in any conservation area at all. The Proteaceae family is regarded as of high priority in the region and in this case we find that of the 206 Proteaceae species listed as threatened in the 2006 National Red List, 157 (76%) occur in formal state conservation areas while an additional 24 species (12%) are conserved within private conservation initiatives.

The total percentage of threatened taxa conserved *in situ* in the Cape Floristic Region is therefore approximately 54%, including about 88% of the region's Proteaceae (these figures are likely to be overestimates of 'effective conservation' as we were unable to distinguish whether species' occurrences in protected areas constituted self-sustaining populations or simply marginal or sink populations). The discrepancy between the above figures indicates that, although the region as a whole is reasonably well conserved, most protected areas are in mountainous habitats where the Proteaceae tend to occur. The fertile, arable lowland habitats, which harbour a large number of threatened species, are under extreme pressure from agriculture, urbanisation and industrialisation and are therefore much more difficult to obtain and maintain for formal conservation.



Localities of the threatened species of the Cape Floristic Region, indicating those that are under formal state protection (○), private conservation (Δ) and those that are not conserved *in situ* (+).

Gathering these fine-scale data, together with the compilation of comprehensive threatened plant lists in each protected area, will allow us to quantify our progress on GSPC Target 7 in the medium term.

Looking to the future

South Africa's new National Environmental Management: Biodiversity Act (2004) legislates the protection of threatened ecosystems and species in its fourth chapter. The specific purpose of this chapter includes 'protection of species that are threatened or in need of protection to ensure their survival in the wild', to 'give effect to the Republic's obligations under international agreements regulating trade in specimens of endangered species'; it is furthermore aimed at ensuring that biodiversity is sustainably utilised [Chapter 4: 51 (b)–(d)]. The Act allows for the regulation of not only activities directly involving threatened or protected species, but also of the processes that threaten them in specifically listed ecosystems (Chapter 4: 53). While the regulations regarding interpretation and implementation of the Biodiversity Act have not yet been resolved, it is a powerful national tool that should be used to further the *in situ* conservation of all threatened species.

It must be noted, however, that the presence of a species or even the inclusion of most of its range in a protected area and *in situ* management strategies do not necessarily ensure the survival of that species in the wild. Although all South African cycads are the subject of strict international, national and provincial regulation, six cycad species have gone extinct over the last 100 years and two, *Encephalartos brevifoliolatus* and *E. nubimontanus*, have been lost within the last three years due to over-harvesting for horticultural trade. This disturbing issue highlights the fact that even the best management plans and conservation strategies will not be successful without integrated *in situ* and *ex situ* conservation plans, stringent law enforcement and ongoing attention.

OBJECTIVE 2: Conserving plant diversity

Integrating *ex situ* and *in situ* conservation

Target 8:

60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes

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Scope

This target focuses on the conservation of threatened plant species within *ex situ* living collections (botanical gardens, seed banks and tissue culture collections). Priority should be given to the conservation of critically endangered species, 90% of which should be conserved in *ex situ* (off-site) collections. The target also suggests that 10% of threatened species should be included in recovery and restoration programmes, providing the necessary link between *ex situ* and *in situ* (on-site) conservation.

Achievements

Since the world-renowned Kirstenbosch National Botanical Garden was established in 1913, ongoing efforts have been made to conserve threatened South African indigenous plants within botanical gardens. South Africa currently has a network of eight national botanical gardens (NBGs), spread across five of South Africa's nine provinces that are managed by the South African National Biodiversity Institute (SANBI). Part of the mandate of these botanical gardens is to focus on the conservation of South Africa's indigenous plants, and since 1913 various botanical gardens have been working closely with, and have been supported by, the Botanical Society of South Africa, a key nongovernmental organisation that promotes plant conservation in South Africa.

All South Africa's NBGs have committed themselves to implementing the *International Agenda for Botanic Gardens in Conservation*, which promotes the fundamental premise of integrated conservation strategies, combining resources of land and habitat management, biological research, database and information management, and *ex situ* propagation and cultivation. The *International Agenda* has set global targets related to the objectives of the GSPC, and the targets that relate to Target 8 of the GSPC are (a) 50 per cent of threatened plants included in accessible botanical garden *ex situ* conservation collections, including cultivated and genebank material, preferably in the country of origin, and (b) 75 per cent of critically endangered plant species included in *ex situ* conservation collections by 2010, preferably in the country of origin.

A survey of the *ex situ* conservation collections in South Africa's NBGs undertaken in 2002 produced some useful baseline statistics from which the gardens could set meaningful targets. Results from this survey indicated that some 8 500 indigenous plant taxa are grown in the NBGs, or 39% of South



The partnership between SANBI and Kew's Millennium Seed Bank Project plays a valuable role in the conservation of South Africa's indigenous and threatened plants.

Photographs: Millennium Seed Bank



The Endangered *Aloe peglerae*, depicted in this drawing by botanical artist Gillian Condry, is found mainly on the Magaliesberg and Witwatersberg in Gauteng and the North-West Province. An integrated conservation programme between Gauteng Nature Conservation and the Walter Sisulu National Botanical Garden in Roodepoort/Mogale City is currently being implemented.

Africa's 21 721 indigenous plants in an area of about 1 350 ha. The number of indigenous plant species per garden ranges from 347 species in the Free State Garden to 5 538 species in Kirstenbosch. Kirstenbosch, one of the world's premier gardens, is thus representative of 25% of South Africa's plant species on its grounds. A total of 813 Red List plant species are represented throughout the NBGs, 384 being regarded as threatened. Almost half of all the Red List species in South Africa's NBGs were identified as 'low priority' (Rare or Lower Risk) species. Clearly, this reflects a need to increase the number of threatened species (Critically Endangered, Endangered and Vulnerable) in South Africa's NBGs. Threatened species from the families Proteaceae, Amaryllidaceae, Aloaceae and Iridaceae are the most well-represented in the NBGs. They are mainly showy, well-known and highly attractive species that appeal to garden visitors. Of concern is that 64% of Red List species in South Africa's NBGs occur in only a single collection. It is generally regarded that a large number of accessions held in one location are at greater risk than an equivalent number spread across several botanical gardens. Various recommendations were made in the 2002 survey, including the re-focussing of efforts on particular plant species and the development of a comprehensive plant conservation strategy for South Africa's NBGs, which includes appropriate targets and indicators that are measurable.

Various universities and municipal botanical gardens within South Africa are also involved in conserving South Africa's threatened plant species, including the development of protocols for the cultivation and propagation of threatened indigenous plants.

Millennium Seed Bank Project

Seed banking is regarded as one of the tools used in the conservation of plant species. A strategic 2-phase (2000–2005 and 2005–2010)



South Africa's National Botanical Gardens serve as embassies of biodiversity and culture. Photographs: Christopher K. Willis

Kirstenbosch *ex situ* cycad collections support *in situ* conservation efforts

South African plant scientists have been conducting research on cycads for several decades. One of the more recent projects has been a study on the endangered *Encephalartos latifrons*. This South African cycad is endemic to a very small region of the Eastern Cape, and in addition to being naturally rare, this plant is Endangered as a result of over-collection and trade. Fewer than 60 plants remain in the wild, all of them highly isolated from each other, a situation which is thought to be preventing natural pollination. No naturally growing seedlings have been recorded in over 100 years. To supplement *E. latifrons* numbers, wild plants have been cultivated at Kirstenbosch National Botanical Garden for several decades. The garden now houses the world's largest *ex situ* collection of this species, totalling 37 plants (18 adults, 19 seedlings) but because the geographic origins of the Kirstenbosch collection are unknown, there was a possibility of compromising the genetic integrity of the species by using these plants to supplement wild populations. Additionally, a fool-proof method of establishing the origin of confiscated plants was needed to assist law enforcement authorities to halt further illegal collection.

Genetic studies were undertaken at the Leslie Hill Molecular Systematics Laboratory, SANBI, Kirstenbosch, to determine the genetic diversity and population structure of *E. latifrons* in the wild, as well as to establish the genotype of the *ex situ* collection at Kirstenbosch and assign these individuals to their closest extant wild population. The results showed very high proportions of genetic diversity both in the wild and at Kirstenbosch, but it appeared that all individuals originate from a single population. The results also revealed adequate levels of gene flow between wild individuals at different localities and, at least historically, a sexual mode of reproduction. Additionally, six distinct genotypes were found in the wild and all of these are represented in the Kirstenbosch collection. The *ex situ* collection of cycads is therefore an excellent source of genetic material for the conservation of the species and translocation and artificial fertilisation projects can now be initiated using plants from the wild and Kirstenbosch.

Restoration of Kenilworth Conservation Area



Restoration of the threatened *Erica verticillata* (Ericaceae) by Kirstenbosch horticultural staff, in collaboration with the Millennium Seed Bank Project and local conservation authorities, to its natural habitat of the Kenilworth Race Course near Cape Town. Photograph: Adam Horrower

The privately owned Kenilworth Conservation Area (KCA) of 41.96 ha comprises vegetation described as Sand Plain Fynbos of which only 1.7% is conserved. The KCA contains a total of 331 different plant species, 19 of which are listed as Red Data species; in addition, six species occur only in the KCA. The area is currently being restored in partnership between the Western Cape Nature Conservation Board (Cape Nature), Kirstenbosch National Botanical Garden and the MSBP. Sand Plain Fynbos needs fire to maintain an optimum level of biodiversity and

to rejuvenate towards an optimum vegetation age distribution. In March 2005, 10 ha of the KCA was burned by Cape Nature for the first time in 100 years. Before burning, seed of the most important species was collected by MSBP staff and volunteers, and deposited as a backup in the Millennium Seed Bank. In late May, about 250 seedlings were planted of two species that occurred naturally in the area, but had been extinct in the wild for many years. A recent inspection revealed that the plants are doing very well and some have even started flowering.

DNA Bank at Kirstenbosch

The South African Plant DNA Banking Facility has been established as a collaborative project between SANBI and the Royal Botanic Gardens, Kew, funded by the UK Darwin Initiative. Based in the Leslie Hill Molecular Systematics Laboratory in Kirstenbosch, one of the objectives of the DNA bank is to archive at least one representative of each genus of plants indigenous to South Africa (there are an estimated 2 200 flowering plant genera known in South Africa). Another objective is to produce a phylogenetic 'tree of life' of South African plant genera and identify areas of endemism and high priority for conservation.

Cryo-conservation Centre of Excellence for Sub-Saharan Africa

In 2005, the UK Darwin Initiative awarded a grant to the MSBP to work with researchers at the University of KwaZulu-Natal, Durban, South Africa, to establish a Cryo-Conservation Centre of Excellence for Sub-Saharan Africa (CCESSA). The centre will conserve socio-economically important recalcitrant seed species from the continent using ultra low-temperature storage techniques, and provide education and training. The CCESSA will make available plants used for traditional medicine or 'muthi' plants (thereby reducing pressure on wild populations) through *in vitro* (micro-)propagation of *ex situ* cryo-preserved material as well as through appropriate macro-propagation methods.

partnership was developed between SANBI and the Millennium Seed Bank Project (MSBP) of the Royal Botanic Gardens, Kew, in 2000. Through this partnership, SANBI aims to have at least 2 500 of South Africa's indigenous seed-bearing plants conserved in *ex situ* collections at the MSBP and to duplicate collections at a national seed banking facility in South Africa by 2010. Currently, the MSBP holds seed collections of over 1 500 of South Africa's plant species. More than 80% of these collections are of threatened, endemic or useful species. In collaboration with SANBI's Threatened Species Programme and conservation authorities in South Africa, the project has been working on increasing the number of collections of priority taxa, such as threatened species and species endemic to South Africa. To date, approximately 187 species occurring in the latest national Red List are represented in the collection. Of these, 61 were assessed as threatened and three as extinct in the wild. In Phase 2 (2005–2010) of the project, methodologies have been developed to increase the number of collections of threatened plants.

While restoration efforts involving threatened plants within South Africa have been limited, SANBI and the MSBP have collaborated with other partners in several reintroduction and restoration programmes in the Mpumalanga, Eastern Cape and Western Cape Provinces.

Looking to the future

With over 1 000 threatened indigenous plant species in South Africa, the challenges facing South Africa's NBGs are immense, and they will have to prioritise their conservation efforts to make a meaningful contribution to the conservation of the country's indigenous flora. Following the 2002 survey of threatened plants in NBGs, a more comprehensive survey has to be conducted within the country once the new Red Data List for South Africa has been completed, to determine the baseline information on holdings

of threatened plants in botanical gardens, nurseries, genebanks and, where possible, private collections. Extensive collections of South Africa's threatened succulent plants are held by amateur plant collectors, which could contribute significantly to the country's conservation efforts. Botanical gardens in South Africa should focus on endemic South African plants and those Red List plants threatened with extinction, rather than 'low priority' taxa. Collection strategies should focus on areas in close proximity to NBGs and simultaneously on areas with the highest concentration of Red List species. *Ex situ* conservation priority should also be given to species of local economic importance, species of special scientific interest or local 'flagship' species that will stimulate conservation awareness and can be incorporated into education and fundraising programmes.

Once horticultural protocols have been developed for individual threatened plant taxa, duplicate material should be held in different gardens and collections, thereby reducing the risk of the entire *ex situ* stock being lost. Genetic diversity of *ex situ* conservation collections is an area not addressed by this target, although attempts should be made to hold as diverse a genetic representation of a species as possible. Close collaboration with Botanic Gardens Conservation International (BGCI) and other international (mostly European) botanical gardens holding South African threatened plant collections should be encouraged.

Over the next five years, integration of *ex situ* and *in situ* conservation efforts must also be a priority for South Africa's botanical gardens holding conservation collections. Monitoring and evaluation of the conservation role and status of collections in botanical gardens must furthermore become a regular function of each botanical garden in South Africa, together with the development of appropriate strategic partnerships (at local, national and international levels) that support their conservation programmes. It is important that different institutions holding *ex situ* conservation collections in South Africa collaborate in conserving the prioritised threatened plant species by 2010.

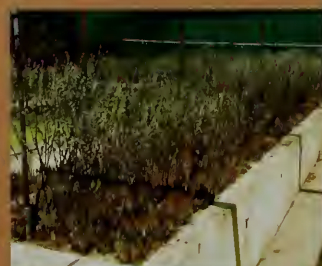
The MSBP will be looking at ways of developing the programme further in South Africa, comprising a fully integrated conservation strategy. This strategy will aim to encompass seed collection and long-term storage, propagation, distribution, research, training and where appropriate, reintroduction. It aims to develop partnerships with a wide group of conservation practitioners in South Africa.



Didymaotus lapidiformis (Mesembryanthemaceae), one of the flagship threatened plants selected for cultivation by the Karoo Desert National Botanical Garden, Worcester.
Photograph: Christopher K. Willis



Conservation collections in the Walter Sisulu National Botanical Garden.
Photograph: Christopher K. Willis



National botanical gardens play an important role in the conservation of indigenous South African plants. *Haworthia maxima*, rescued from a development site in Worcester, has been bulked up in the Karoo Desert National Botanical Garden and will be returned to the site once the building development has been completed.
Photograph: Christopher K. Willis

The Nelspruit Cascades form a spectacular sight in the Lowveld National Botanical Garden, Mpumalanga. All South Africa's eight national botanical gardens conserve large areas of natural vegetation within their boundaries.

Photograph: Christopher K. Willis

OBJECTIVE 2: Conserving plant diversity

Conserving crop diversity

Target 9:

70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated local and indigenous knowledge maintained

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Scope

Target 9 covers the conservation of all major crop species such as vegetables, cereals, pasture grasses, pasture legumes, other crops, trees and flowers as well as socio-economically valuable species including medicinal plants, plants with value for building material, wood, fencing and erosion control.

Achievements

The conservation and utilisation of plant genetic resources for food and agriculture is one of the prime functions of the Directorate Genetic Resources Management of South Africa's national Department of Agriculture. South Africa is currently engaged in the process of ratifying the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), while the Directorate is also developing a policy for the conservation and utilisation of genetic resources for food and agriculture. This policy will be further informed by a revision of the priority crops in South Africa in 2006.

The National Plant Genetic Resources Centre (NPGRC) for plant genetic resources for food and agriculture falls under this Directorate. The present mandate of the NPGRC is the collection and conservation of:

1. Indigenous crops landraces, namely sorghum, millets, cucurbits and the genus *Vigna*.
2. Crops that have become locally adapted (landraces).
3. Wild relatives of crop species.
4. Leafy vegetables.

The NPGRC works according to mandated species lists compiled within the SADC Plant Genetic Resources Network. A total of 436 priority species divided into seven groups have been identified.

Owing to the diversity of people in South Africa, tribal customs and varying climatic conditions, crops have been subjected to many imposed selection criteria, resulting in varied but stable landraces. The challenge is the conservation of these landraces and the re-introduction of these adapted ecovars into agriculture in areas where they are best adapted. Extensive collections of landrace germplasm have been made in South Africa and landraces are very well represented in the collection. All landrace crop accessions are accompanied by detailed passport data, including data pertaining to indigenous

Sorghum bicolor variation.
Photographs: National Plant Genetic
Resources Centre, South Africa

practices such as plants used, plant parts used, threshing, drying, treatment and storage methods, land preparation, cropping system and traditional beliefs and taboos. Although it is possible to contain genetic diversity in relatively small samples of a particular genotype, the process of natural selection imposed during the development of the landrace will necessitate the conservation of genetic diversity of each of these ecovars separately. Combining the accessions will dilute the influence of human and climatic selection pressures.

Furthermore, plants are not only cultivated for their use as food or agricultural crops but can also play a role as medicines and are used in tribal rituals. Many of these plants are not directly cultivated but harvested in the wild. Together with additional pressures due to large-scale urbanisation of the population, this leads to more stress on the plants in nature. The situation is exacerbated by injudicious harvesting practices and by a demand created by numerous 'muthi' shops in the cities.

In South Africa, about 80% of the country is rangeland and it can be profitably utilised only by producing livestock. The importance of this rangeland is thus closely linked to livestock production. The risks involved do not relate only to an important source of income for first- and second-economy farmers, but also to the natural resource which is continuously exposed to pressures such as over-utilisation and annual fires. The combination of such pressures on the rangeland and especially the concentration of livestock in restricted areas, be it as a result of drought, fire or communal restrictions, places serious stresses on biodiversity.

The Agricultural Research Council–Livestock Business Division (ARC–LBD) Forage Genebank holds a collection of approximately 8 000 accessions. The collection consists of 2 784 grass accessions of which 80% are indigenous, 4 268 legume accessions of which 5% are indigenous and 320 other plant species of which 84% are indigenous. Although these accessions are mainly species with fodder value, there are also species that can be used for other purposes such as rehabilitation and erosion control. However, this refers to only a limited number of plants in the target group.

Looking to the future

Although extensive landrace crop collections have been made, attention has to be paid to ecogeographic coverage and diversity studies which will contribute to an extensive gap analysis. Furthermore, there has to be a shift towards the collection and *ex situ* conservation of wild crop relatives and prioritised wild species used for food and agriculture. *In situ* conservation of crop species (on-farm conservation) will also be a priority focus in the future and plans are already under way for implementing on-farm conservation.

The future of crops in South Africa will largely be determined by education and creating awareness of the role of cultivated plants not only in the farming community, but also amongst the general public and consumers of the crops. Conservation of diversity in expanded genebanks and nurseries and the collection and categorisation of the sources of genetic diversity linked to special training of local communities, in cases where diversity is under threat, are also required.

Increasing the indigenous legume holdings in the ARC–LBD Forage Genebank is a high priority. Currently only about 5% of known legume seed is conserved and maintained in the Forage Genebank. Of the approximately 1 580 species, 14 are endemic to regions such as the Western and Eastern Cape (Germishuizen & Meyer 2003). An extensive study to ascertain the potential agricultural value of mainly herb and shrub legumes of southern Africa is in progress.



Okra fruits and maize cobs.
Photographs: National Plant Genetic
Resources Centre, South Africa



Indigenous legumes stored in
the collection of the ARC–LBD
Forage Genebank. Top: *Psoralea repens*. Below: *Tephrosia*
species.
Photographs: National Plant Genetic
Resources Centre, South Africa

OBJECTIVE 2: Conserving plant diversity

Taking control of biological invasions

Target 10:

Management plans in place for at least 100 major invasive alien species that threaten plants, plant communities and associated habitats and ecosystems

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Scope

Invasive alien organisms are regarded as the second most important threat to biodiversity worldwide. Many types of invasive organisms have a major impact on plant diversity in South Africa. Despite a long history of research and management of invasions in South Africa, the increased knowledge base, better global collaboration, innovative research, recognition by government of the challenges posed by biological invasions to biodiversity, and new far-reaching legislation, the stage is set for a radical improvement in strategic management of invasions.

Achievements

The management of biological invasions in South Africa took a giant leap forward with the launching of the Working for Water (WfW) programme of the Department of Water Affairs and Forestry in 1995. Although many successful control operations against invasive species were in place before this date, WfW provided the foundation for the initiation and, more importantly, the sustainability of control programmes at local, regional and national scales throughout South Africa, including biological control. WfW has grown rapidly—at the end of the 2005, the programme comprised 303 projects located in all nine provinces of South Africa, employed more than 25 000 people, and had cleared over 1.5 million ha of invaded land. The programme has been lauded internationally for its vision in simultaneously addressing environmental and socio-economic issues. As the name of the programme implies, WfW initially focussed largely on the control of invasive species with the specific aim of alleviating the well-documented impacts on water resources. As such, it represents a model case of the leverage of conservation action based on a scientific evaluation of the value of ecosystems services and the threats to these from invasive species. The focus of the programme has been expanded to deal with all invasive plant species, not only those with clear impacts on water resources. Details of the Working for Water programme are on the web at: <http://www.dwaf.gov.za/wfw/>.

Over the past decade, special attention has been given to the prioritisation of invasive alien plant species when formulating national, regional and local-scale control operations. Following the broadening of the scope of the WfW



Cutting firewood from rooikrans (*Acacia cyclops*) in the Western Cape.

Photograph: Ben-Erik von Wyk. From: *People's plants—a guide to useful plants of southern Africa*, by Ben-Erik von Wyk & Nigel Gericke, published by Brizo Publications, www.brizo.co.za



The Working for Water programme has improved public awareness of the threats posed by invasive alien plants to the environment, South Africa's economy and human livelihoods.

Photograph: Christopher K. Willis



Commercial forestry managers have to monitor the encroachment of alien invasive plants into patches of natural vegetation regularly.

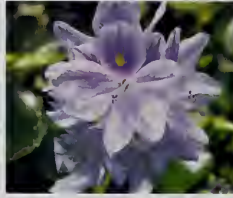
Photograph: Christopher K. Willis

programme to include all invasive species, and not only those that affect water resources directly, attention has been given to species other than trees and shrubs, which used to be the main focus of previous control efforts. For instance, invasive grasses have been identified as being highly problematic and threatening to biodiversity and ecosystem functioning in many South African ecosystems. Many alien grasses are likely to become more widespread with escalating global change.

A classification system was devised for prioritising invasive plant species for management in South Africa. The system, drawing on data from the SAPIA database, defines 117 major invasive species categorised into groups based on geographical range and abundance, and 84 emerging and minor invaders categorised into groups based on the current extent of the species and the potentially suitable habitat in South Africa. The groups within these two main categories are useful for defining strategies for control. For example, for the major invaders, very widespread and abundant species typically require multifaceted, national-scale operations for containment and ecosystem management, whereas less abundant species with more localised distributions are suitable for regional or local-scale initiatives and may be suitable for eradication efforts. Such compartmentalisation of strategies will improve the effectiveness of interventions.

Effective management of biological invasions calls for interventions at all stages of the invasion process. Considerable strides have recently been made towards more effective prevention of invasions in South Africa. The National Environmental Management: Biodiversity Act (10 of 2004) contains far-reaching regulations relating to many aspects of alien organisms and management thereof. Included in the regulations of the Act that are currently in preparation is a *Guideline Framework for the Assessment and Management of Risk* which provides assistance

Biological control of invasive plants in South Africa



Water hyacinth (*Eichhornia crassipes*) and the water hyacinth weevil (*Neochetina bruchi*).

Photographs: Carina J. Cilliers

South Africa is one of the leading countries in the world in the field of biological control of invasive alien plants. The Department of Agriculture pioneered biological control in South Africa with the successful programme against prickly pear in the early 1900s. Since then, and mainly under the helm of the Plant Protection Research Institute (PPRI), 42 plant species have been targeted with the release of 96 biological control agents. Currently biological control programmes are in progress against many of the major and some of the emerging invasive plants in South Africa. This initiative involves a partnership between the PPRI, several universities and the Working for Water programme. Importantly,

biological control forms an integral part of national control initiatives. Special attention is being devoted to targeting emerging invaders for biological control, realising the major benefits of halting the spread of alien plants at an early stage of invasion. To date, biological control programmes have been launched against some 20 species of emerging weeds. Complete control has been achieved for several species, including the red water fern *Azolla filiculoides* and the moon cactus *Harrisia martinii*.

Monitoring the emergence and spread of invasive plants



Field guides that can assist participants in the SAPIA project

The Southern African Plant Invaders Atlas (SAPIA) is an important resource for planning the effective control of invasive alien plants in South Africa. SAPIA, compiled under the auspices

of the Plant Protection Research Institute, is a computerised database that catalogues the localities of naturalised and invasive plants in this region. The SAPIA database currently catalogues almost 60 000 records of 600 plant taxa over a period of three decades. From 2006, the SAPIA database will be accessible via the internet, allowing the public to obtain and contribute information that will assist in monitoring the emergence and spread of invasive plants.

Nurseries Partnership Programme

The Nurseries Partnership Programme (NPP) is a joint venture between the Working for Water programme, the South African Nursery Association (SANA) and the National Department of Agriculture (NDA) to address the problem of invasive alien plants within the nursery industry and among the gardening public. NPP has six main aims:

- To ensure that nurseries do not stock or sell species that are known to be invasive or that are potentially invasive.
- To dissuade customers from buying invasive species through a comprehensive media awareness campaign.
- To garner support from the nursery sector for the Working for Water programme and other initiatives directed at managing invasive alien species.
- To develop a system of endorsement for nurseries that conform to the regulations of the National Environmental Management: Biodiversity Act (10 of 2004), and which encourages the planting of indigenous and noninvasive alien plants as well as 'water-wise' and 'low maintenance' gardening practices.
- To ensure that nursery staff are equipped to answer questions from customers about invasive species and alternative indigenous and noninvasive alien plants.
- To initiate and encourage the partnership between nurseries and emerging community-based growers.

The implementation of the partnership has three main components: research, training and communication.

in determining and taking appropriate management responses to the risk of potential or actual invasive alien species. The guidelines define, for the first time in South African legislation, certain 'prescribed activities' that: (a) act, or potentially act, as pathways for the unintended introduction of species into South Africa that pose a high risk of becoming invasive; or (b) potentially disseminate high-risk species within the borders of South Africa. The guidelines also define a protocol of risk assessment for species introduced into South Africa. Provision is furthermore made for assessment of the risk of introduced species acting as vectors for the simultaneous introduction of other species (e.g. introduced plants carrying pathogens). The guidelines also provide a framework for the objective assessment of the actual or potential invasiveness of alien species already in South Africa. This framework provides a benchmark for the allocation of priorities and responsibility for management. For example, this allows for the objective categorisation of whether, for a particular species, eradication is a feasible goal of management, and the extent to which land users and other individuals can play a role in helping to bring the species under control, as part of an integrated programme. Alien species with important economic or social benefit for the country can be regulated by area, with persons or organisations utilising such species under permit to be held accountable for the invasive spread of the species.

Considerable progress has been made towards a systematic approach for managing biological invasions in South Africa to alleviate the major threat that invasive organisms pose to the country's biodiversity, including its rich flora. An obstacle to further progress and implementation of plans is the shortage of human resources needed to drive such programmes into the future. A milestone towards solving the capacity problem for managing biological invasions, was the establishment of the Centre for Invasion

Global Invasive Species Programme



The mission of the Global Invasive Species Programme (GISP) is to conserve biodiversity and sustain human livelihoods by minimising the spread and impact of invasive alien species.

The Global Invasive Species Programme (GISP) has been designated as the Lead Institution by the Convention on Biological Diversity to facilitate stakeholder consultations, the outcomes of which will guide the implementation of actions to achieve Target 10 of the GSPC. The GISP Secretariat is located at Kirstenbosch in Cape Town, South Africa, and South African organisations are involved in many of the GISP initiatives, among them the consultation to identify the 100 major alien species that threaten plants and plant communities carried out in 2004. The evaluation sought to identify the most important taxa of invasive species impacting on biodiversity in terrestrial, freshwater, marine and coastal and other ecosystems, including urban systems. Emphasis was placed on assessments in biodiversity priority areas, e.g. hotspots,

Important Plant Areas and protected areas. Impacts were also assessed with regard to agricultural biodiversity, economically valuable plants and with respect to Red Data lists. Details of GISP activities are available at: <http://www.gisp.org/>.

Biology (CIB; www.sun.ac.za/cib) in 2004. It is one of six Centres of Excellence created by South Africa's Department of Science and Technology in all fields of science (<http://www.dst.gov.za/centres/index.php>). Creation of the CIB points to the recognition of biological invasions as a major challenge to the South African environment. South Africa has made substantial contributions to the international scientific knowledge base in the past. The formation of the CIB provides a platform and critical mass for further research on key issues relating to the management of invasive species. In its first year of existence, the CIB supported more than 40 students.

An important obstacle to the implementation of more effective management of biological invasions is the lack of public awareness of the dimensions of the problem and ways in which involvement of individuals and groups could help to alleviate the problem. Various education programmes have been launched in the past decade, mainly under the auspices of the Working for Water programme. An important example is the Nurseries Partnership Programme that was launched to increase awareness of the problem of garden plants as invasive species.

Effective tackling of invasive alien species demands international co-operation. South Africa is a signatory to various international conventions that relate in some way to invasive species, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention on Biological Diversity, and the International Plant Protection Convention. Global interactions in many areas relating to invasive species are facilitated by the Global Invasive Species Programme (GISP). Within Africa, South Africa is a key player in the New Partnership for Africa's Development (NEPAD) initiative and has initiated various projects on invasive species within the Environment Initiative of NEPAD (see <http://www.environment-directory.org/nepad/content/invasive.asp>).

Looking to the future

The considerable progress on numerous fronts over the past decade means that South Africa is well prepared to address the escalating challenges resulting from the spread of invasive alien species. Control initiatives, notably the Working for Water programme, are well established, and with improved systems for planning in place, the effectiveness of control measures is likely to improve. The scientific foundation for WfW is being improved with ongoing research in all key areas of the programme. More attention is being given to the restoration of areas cleared of invasive species—to prevent re-invasion by the same species or a new suite of invaders, and to restore elements of biodiversity and ecosystem function. Some progress has been made towards defining economic incentives for restoring natural capital in invaded ecosystems, but further work is needed in this direction. Further engagement is required with individuals and organisations that derive benefits from invasive or potentially invasive organisms. For plants, at least 180 species of alien species, introduced and utilised for their perceived forestry and horticultural benefits, are well known invaders and many others are likely to become invasive soon. Further incentives and punitive measures are required to regulate the further importation of alien species and the management of those species already in use. The regulations of the National Environmental Management: Biodiversity Act will be crucial in this regard.

Innovative measures are being sought for dealing with invasions in ecosystems that are highly susceptible to invasion, such as riparian zones. Decision-making frameworks for prioritising clearing and restoration in such areas are



Since 1995, the Working for Water programme has made a significant contribution towards poverty alleviation, job creation and skills development in South Africa.

Photograph: SANBI



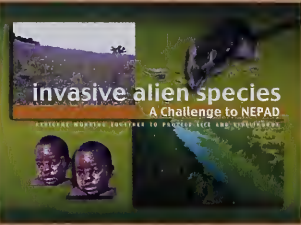
Australian acacias (particularly *Acacia cyclops* and *A. saligna*) were originally planted along the Western Cape coast by state forestry authorities in the 1870s to stabilise areas of windblown sand. This policy, which has now been reversed, has resulted in tremendous losses of coastal vegetation types. Many of these alien invasive species still present a threat to South Africa's coastal dunes.

Photograph: Christopher K. Willis

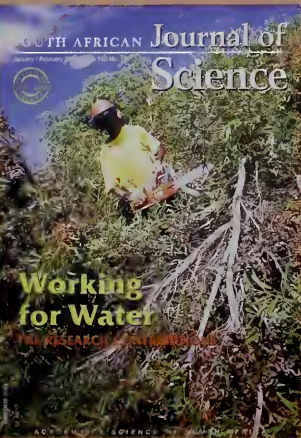


Training students in invasion ecology is a key challenge. The picture shows Ph.D. student Sebataolo Rahlaol (extreme left) discussing his project on the invasive grass species *Pennisetum setaceum* with researchers in the field.

Photograph: David M. Richardson



The problem of invasive species was identified as one of eight areas for intervention in the Action Plan for the environment component of NEPAD, along with combating desertification, wetland conservation, coastal management, global warming, cross-border conservation areas, environmental governance and financing.



Scientific research on all aspects of biological invasions is crucial for the development of effective management programmes. A special issue of the South African Journal of Science was devoted to research related to issues relevant to the Working for Water programme.

being developed. Meaningful interventions in such areas are very expensive, and cost:benefit ratios must be calculated to leverage funding for such operations.

Elements of global change are altering the dimensions of the problems caused by invasive alien species. Management strategies have to be flexible enough to address new challenges and to capitalise on emerging opportunities.



Before and after biological control of the red water fern *Azolla filiculoides* by the leaf-feeding weevil *Stenopelmus rufinus*. Photographs: A.J. McConnachie

OBJECTIVE 3: Using plant diversity sustainably

Preventing plant extinctions due to unsustainable international trade

Target 11:

No species of wild flora endangered by international trade

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Scope

The emphasis of this target is on ensuring that international trade in plants and plant products does not lead to the endangerment or extinction of plant populations in the wild. International trade in plants is a massive global industry involving the yearly export and import of millions of plants and tons of plant products. Plants of South African origin are well known in the horticultural trade but almost all of this trade is in cultivated varieties and has no negative effect on wild populations. However, trade in wild-harvested plants is an important component of the cut-flower industry (e.g. fynbos species such as proteas, restios, and ericas), certain medicinal and herbal products (e.g. aloe, rooibos tea, hoodia, devil's claw, buchu), the timber trade, and trade in some horticultural species (for seeds or plants). The challenge, in terms of this target, is to ensure that trade does not lead to the ecologically unsustainable exploitation of wild populations.

The extent of the challenge is determined by the precise formulation of Target 11, that no plant species will be endangered through international trade. To put this in context, at least 40 South African plant species on the IUCN Red List are threatened in part by international trade. An estimated 550 species of plants are also traded for medicinal and traditional purposes within South Africa, and there is a significant trade with neighbouring countries. The extent and impact of this trade is poorly known but popular species are becoming difficult to obtain in South Africa. In particular groups such as cycads and some succulents, trade is one of the major threats. Two species of cycad in South Africa have recently been classified as Extinct in the Wild due to illegal harvesting, a trade that satisfies both domestic and international demand, and a further 16 species are listed as either CR (Critically Endangered) or EN (Endangered) and are declining due to illegal trade. South Africa can therefore make a significant contribution to Target 11 by reducing the risk imposed by international trade to all these species.

Achievements

CITES is the main mechanism for regulating international trade in endangered species. South Africa became a Party to CITES in 1975 and some South African plant species were among the first taxa to be listed on the CITES Appendices. At present, 1 005 South African plants are listed on the CITES Appendices, 42 on Appendix I and 963 on Appendix II. During the past five years, ongoing assessments of plants in trade resulted in one species (*Aloe thorncroftii*) being downlisted from Appendix I, due to a decline in threat from trade, and the genus *Hoodia* being listed on Appendix II due to a high demand for wild plants to manufacture herbal appetite suppressants.



All species of Aloe are included on CITES lists. However, only four southern African species, including *Aloe olbido* (Asphodeloaceae), are included on CITES Appendix I.

Photograph: Christopher K. Willis



Cycad collections in the Kirstenbosch National Botanical Garden.

Photograph: Christopher K. Willis

The regulation of trade in threatened species was further strengthened in 2004 by the promulgation of the National Environmental Management: Biodiversity Act. The Act provides for regulations to restrict trade in threatened species and will strengthen the implementation of CITES in South Africa and the control of trade in threatened species. New regulations will be published in 2006.

One of the constraints on enforcing trade regulations has been the inability of law enforcement agencies to identify illegally harvested plants. South African nature conservation agencies have therefore pioneered the use of microchips to identify individual plants of highly threatened species, such as cycads. This technology has been effective for about 10 years but collectors have now found ways to circumvent the chips. As a result, scientists at SANBI have been working together with nature conservation agencies in Gauteng and Mpumalanga Provinces to evaluate the use of DNA fingerprinting as a way of identifying illegal plants in trade. Pilot studies were initiated in 2004 and will be completed in 2006.

Cultivation can reduce the threat to wild populations by making propagated plants more readily available. This has been particularly successful in South Africa for some aloes and other succulents as well as some medicinal plants such as *Siphonochilus aethiopicus*, and trials are currently under way for the large-scale cultivation of *Hoodia* species to reduce the threat to wild populations. The network of National Botanical Gardens in South Africa has also focused on the propagation of indigenous plants and this has greatly increased the availability of cultivated material as well as information on propagation. Access to this information has been improved through the publication of gardening books and making information available on websites such as www.plantzafrica.com (see Target 3). In addition, pioneering work in South Africa on the use of smoke as a stimulant for seed germination resulted in far easier propagation of important horticultural species such as proteas and restios.

Cultivation is not the only viable option. If properly managed, harvesting from the wild can contribute to livelihoods without endangering wild populations. For example, devil's claw (*Harpagophytum* species) is harvested by poor communities as part of the international trade in herbal arthritis remedies. SANBI has worked together with TRAFFIC, FFI, Resource Africa and local conservation authorities and communities to evaluate the sustainability of trade in devil's claw. Other agencies have also developed innovative programmes to promote fair and sustainable trade in rooibos tea (*Aspalathus linearis*) and for the sustainable use of a range of fynbos species in the Cape Floristic Region as part of the Cape Action for People and the Environment (C.A.P.E.) programme.

Looking to the future

To meet its obligations for Target 11, South Africa has to facilitate trade in cultivated or sustainably harvested plants in a better way and, at the same time, restrict trade from unsustainable sources more effectively. Wherever possible, this means working together with user groups to understand the dynamics of trade better and to find solutions to unsustainable trade. The NBSAP identified unregulated trade in medicinal plants as a key area for further work and it must be a priority for the next five years. The basis for sustainable harvest of many species, including heavily utilised ones, is still poorly known and has to be assessed and incorporated into adaptive management plans. At the same time, further interventions are required for trade that is already regulated through CITES and national or provincial legislation.

Preliminary assessment of some *Aloe* and *Euphorbia* species will take place as part of a CITES-significant trade review process. Plans are also being developed to undertake population and habitat viability analyses (PHVA) for Critically Endangered cycad taxa, as part of a process to develop more effective plans to boost populations and to limit the impact of illegal trade.

Finally, monitoring of species potentially threatened by trade has to be strengthened. The recent revival of cycad monitoring in several provinces has shown how populations have declined over the past 10 years and will be essential to measure the effectiveness of any new interventions. TRAFFIC East/Southern Africa has also emphasised the need to monitor the timber trade in southern Africa since this trade can have a large impact on wild populations.



A consignment of illegally harvested cycads in the Eastern Cape Province.

Photograph: John S. Donaldson

Wild ginger (*Siphonochilus aethiopicus*), threatened through over-exploitation for the medicinal plant trade, in cultivation in the Silverglen Nursery, Durban, KwaZulu-Natal.

Photographs: Geoff Nichols



OBJECTIVE 3: Using plant diversity sustainably

For richer or poorer—sustainable use in one of the world's most biodiverse developing countries

Target 12:

30 per cent of plant-based products derived from sources that are sustainably managed

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Scope

Target 12 relates to one of the three objectives of the Convention on Biological Diversity and is a critical element of conservation strategies in developing countries. Principles of sustainable use recognise the biological imperatives of renewable resource use, the benefits that plant resources offer to humankind and the concomitant value placed on resources sustaining livelihoods globally.

Achievements

As one of the biologically most diverse countries in the world, South Africa's resource base offers countless plant species of interest to both domestic and foreign consumers. Arguably the most extensive individual consumption of indigenous plant resources is that of rural South African households who facilitate a domestic medicinal plant market that is among the highest in the world. It is estimated that 85% of rural households depend on nontimber forest products to meet their daily needs, while over 95% depend on fibre-based plant resources for construction and utility products.

Indigenous plant resources are an important part of rural livelihood strategies in South Africa because of the impact of direct use not only on households, but also on the production of household incomes. Despite the significance of these resources in the lives of rural people, their sustainable use and management face several challenges. Trade in this sector involves several hundred thousand individuals operating in largely unregulated and informal trade and harvesting environments. As such, the properties, potential uses and risks to the survival of only a handful of species are well known. With no overarching authority yet effectively monitoring this use, management of large-scale plant conservation and sustainable use remains a significant challenge. There are, however, considerable achievements in sustainable use of plant resources, management and commercialisation in individual sectors.

South Africa's agricultural industry is an important producer of plant products for both domestic and foreign consumption. Historically, local conditions led to the development of an industry highly dependent on external resource inputs and complex irrigation systems. More recently, however, sustainable methods are being increasingly taken up by the industry, including those prescribed by international ethical standard authorities. South Africa currently has approximately 515 000 ha of organically certified farmland. While this is far from 30% of agricultural lands in South Africa, growing interest in these products will surely result in continued exponential increases in organic figures. To assist the country in meeting the growing regional and international interest in sustainable products, AFRISCO Pty, a South African organic certifi-



Aloe pluridens, one of South Africa's many *Aloe* species, is usually associated with impenetrable thicket vegetation in the Eastern Cape.

Photograph: Gideon F. Smith



Men gathering reeds, Cape Town.

Photograph: Anthea C. Stephens

cation scheme, and Fair Trade South Africa have recently been established in the country to promote ethical and certifiable production of plant products.

The forest industry in South Africa is widely considered a major success with regard to the sustainable use of resources. Although the indigenous forests of South Africa cover less than 0.5% of the land base, they are offered strong protection under the National Forests Act of 1998. Demands for timber and timber products are therefore met through plantation forestry, which covers approximately 1 554 000 ha of the land base and has maintained a relatively stable level of forest cover from 1990 to 2000. One of the greatest achievements of South Africa's afforestation campaign has been the certification of approximately 80% of commercial timber plantations as well managed according to international standards set by the Forest Stewardship Council. It is from these forests that most of the pulp, paper and roundwood are sourced.

Many indigenous plants traditionally used in South Africa now serve active overseas markets. Some of the most notable of these products are sourced from plant leaves or fruit which, under the right harvest conditions, can be harvested without significantly influencing the long-term viability of the plant. For example, marula pulp is sourced from the fruit of the marula tree and is the signature ingredient in Amarula Cream liqueur, the second most popular cream liqueur in the world. Rooibos or redbush tea is now found in grocery stores all over the world. To assist in the conservation of local populations and meet the ever-growing demand for this product, cultivated rooibos crops have been established and organic and fair-trade-certified rooibos is available on both internal as well as export markets. This international uptake has been noted by regional organisations like Agribusiness in Sustainable Natural African Plant Products (ASNAPP) who work to ensure sustainable use through community development interventions aimed at *in situ* conservation and the application of ethical standards to plant harvesting.

Looking to the future

Over the past few months, the South African National Department of Agriculture has been developing a draft policy on indigenous food crops, due to be released within the year. This policy, and another on organically certified agriculture, will assist with the management and conservation of plant resources and the South African response to national sustainable use and conservation priorities and obligations. More importantly, these policies will be released at a time when increasing demand for indigenous products is showing early signs of risk to population viability, particularly in the absence of effective regulation and monitoring. Examples of unsustainable levels that threaten the viability of the resource population include harvesting of devil's claw (*Harpagophytum* species), bark of certain trees and bitter aloe (*Aloe ferox*).

Progress is also being made in terms of development of knowledge, availability of information and in terms of research into indigenous plant use in South Africa. CPWild (Commercial Products from the Wild) is a multidisciplinary initiative between academics, professionals and practitioners that aims to facilitate the establishment of enterprises through sustainable use of indigenous plants in rural communities. One of the principal objectives is to tackle the lack of information and networking opportunities in the sector. In addition to the growing body of research from academic and other institutions, CPWild and the eThekweni Municipality recently released the Southern African Trade Directory of Indigenous Natural Products (Mander & McKenzie



Women separating marula seeds, South Africa.

Photograph: Anthea C. Stephens



Indigenous and plantation forests of God's Window, Blyde River Canyon.

Photograph: Anthea C. Stephens

2005). This publication provides a valuable resource in the identification of key issues and players in the natural product sector as well as key sources of information for plant use management.

Complementary to this and others mentioned, are numerous initiatives that have been launched to assist in the development of a sustainable and beneficial natural product sector for South Africa. Interventions addressing policy, capacity and information needs have been designed and are beginning to be implemented. Examples of these include initiatives aimed at promoting improved resource harvesting methodologies, indigenous plant seed collection and cultivation and support to fledgling natural product enterprises. IUCN (The World Conservation Union) and partners PhytoTrade Africa (the Southern African Natural Products Trade Association) recently initiated the Natural Futures Programme. This initiative aims to address barriers to the development of a viable, sustainable natural products sector in the region. Among these are an unsupportive trade policy environment, obstacles to producers' access to certification as well as a general lack of awareness amongst consumers and policy makers about the potential of the sector and its ability to contribute to poverty alleviation and sustainable development.

The Fynbos Crops initiative has been set up to promote a sustainable code of practice and monitoring systems for fynbos crops largely destined for the overseas cut-flower market. This initiative forms part of a larger bioregional planning programme aimed at conserving the biological heritage and unleashing the economic potential of the Cape Floristic Region of South Africa—a biodiversity hotspot and the richest plant kingdom on earth. Another noteworthy project that falls under this programme is the Biodiversity and Wine Initiative (see Target 6). As wine from this region makes up almost 3% of the global supply, the Biodiversity and Wine Initiative was developed to ensure that biodiversity conservation was incorporated in industry practices through the promotion of protected areas, improved farming methodology and incentive- and benefit-based marketing and sales. What makes this initiative so important to the region is its alignment with the South African system of Integrated Production of Wine (IPW) under which almost all wine production in the country falls.

Sustainable use and management of plant resources in South Africa is being addressed through a number of promising sector-specific initiatives such as those noted above. However, the lack of co-ordination and availability of information to date has hindered a definitive assessment of the extent to which South Africa is within reach of Target 12 of the GSPC. The role of the South African National Biodiversity Institute, established under the National Biodiversity Act (Act 10 of 2004), has already begun to fill this gap through its mandate to lead the co-ordination, information management and monitoring of the use of South Africa's biological diversity.

OBJECTIVE 3: Using plant diversity sustainably

Sustaining livelihoods—arresting the erosion of ethno-botanical knowledge and related plant resources

Target 13:

The decline of plant resources, and associated indigenous and local knowledge, innovations and practices that support sustainable livelihoods, local food security and health care, halted

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Scope

Target 13 recognises the relationship between plant resources and sustaining health care provision and local food security. It seeks to halt the erosion of traditional knowledge systems that value and explain the use of plants in ethnomedicine and in shoring up food security. Plants and related knowledge are inextricable: neither can be exploited without the other. Accordingly, the prevention of genetic erosion of ethnobotanical subjects falls within the scope of Target 13.

Achievements

As a developing country, South Africa supports a population of over 40 million people, most of whom retain strong cultural links with plants, regardless of whether they live in rural or in urban areas. In many cases, this relationship is one of dependency on plants for fuel, building materials, medicines and food, and to a lesser degree for utilitarian wares. The range of useful plants mirrors the country's enormous botanical diversity, most especially along the eastern seaboard region, where most human settlement has taken place. Considering medicinal plants alone, it is estimated that some 28 million people in South Africa consume approximately 19 500 tonnes of medicinal plant material during 90 million incidents of use each year. A historically declining resource base coupled to a high population growth rate has long been recognised, as has the need to conserve useful plant resources. Some resources are already fully depleted—at least one medicinal species is known to be extinct in the wild.

Progress has been made in inventorying useful resources and documenting the actual practices. These efforts have stemmed largely from historical efforts to serve the commercial objectives of industry and agriculture, for example the development of new medicines, crops, perfumes, flavourants etc. It is only in more recent years that elements of the traditional knowledge of South African cultural groups have been recognised for their contribution to the sustaining of livelihoods, and considered conservation-worthy. In line with international trends, an increasing westernisation of the South African populace has resulted in a partial discarding and displacement of traditional values and knowledge systems in favour of 'modern' paradigms. The concomitant breakdown in traditional cultural transfer systems continues apace, with increasingly less knowledge handed down from generation to generation. Whereas this aspect may prove challenging to reverse, knowledge erosion



The first documented medicinal plant extinction in South Africa: *Encephalartos woodii* at Ngoye, around 1907. Stems are badly damaged by unsustainable *muthi* harvesting.

Photograph: courtesy of Durban Botanic Gardens



Traditional medical practitioners or *izangama* in celebratory *maad*, Kamberg.

Photograph: Neil R. Crouch



Mat-making materials—harvesting reeds at Lake Sibaya, Zululand.

Photograph: Neil R. Crouch



Competing interests—how not to utilise resources. Invasion of primary swamp forest by commercial banana growers within the Greater St Lucia Wetland Park, a World Heritage and RAMSAR Site.

Photograph: Neil R. Crouch



Sustainable harvesting of *Scolopia* bark by a herbalist or inyanga, Ngoye Forest, Zululand.

Photograph: Neil R. Crouch



The Ezimbuzini muthi or ethno-medicinal market, Durban.

Photograph: Neil R. Crouch

has nonetheless been partially checked through documentation of traditional plant use information in literature and other databases. Substantial achievements in this regard are reflected in a number of composite ethnobotanical overviews that include South Africa in their region of geographic cover. Prominent among these are classics on plant medicines by Watt & Breyer-Brandwijk (1962) and on traditional foodstuffs by Fox & Norwood Young (1982). The ethnobotanical volume on common names and uses of South African plants by Smith (1966) has also contributed significantly. More recently Arnold *et al.* (2002) have inventoried the recorded ethnomedicinal subjects of the *Flora of southern Africa* region, in the process identifying 3 423 such taxa from South Africa. Given the dynamic and evolving character of traditional medicine, a complete checklist is inherently ethereal.

South Africa now finds itself well placed, through the PRECIS system of SANBI, to identify more than just the components of the national ethnomedicinal flora. For each taxon, information on distribution, synonymy, life form and broad usage category is known. Based on Red Data Listings, it is also known which taxa are of conservation concern. This information is accessible for consideration during land use planning activities and thus can inform bioregional plans. During the past two decades, research into the character of the trade in medicinal plants in South and southern Africa has shed important light on key, popular and often over-utilised species, providing data to help focus conservation efforts. Studies have progressed countrywide: in KwaZulu-Natal, the Eastern Cape, Gauteng and Mpumalanga, with a contextual overview for the subregion provided by Marshall (1998). Besides their conservation contributions, such market studies have revealed which of the approximately 3 500 medicinal species are worthwhile subjects for phytochemical and pharmacological investigation. Researchers in these disciplines have been particularly active over the past two decades as they continue the search for new medicines—drugs that will support the livelihoods of future South Africans.

Electronic databases on medicinal plants have played a lesser role in stemming the decline in traditional knowledge. Systems such as MEDBASE of SANBI and TRAMED of the Medical Research Council (MRC) (www.mrc.ac.za/Tramed3/) have largely captured information already placed in the public domain through print publications.

Progress in the halting of the decline of the plant resource itself has progressed in a focused manner, with horticulture playing a key role. Low-technology methods for the propagation and cultivation of medicinal species have been developed for most high-profile taxa and even disseminated in the vernacular. These appropriate-technology techniques have been complemented by tissue culture protocols which allow for very rapid multiplication of stock material. Several subsidised medicinal plant nurseries have been established by conservation agencies and even municipalities to address the decline in high-value, popular species of which the genetic bases have been severely eroded. Most notable of these establishments has been the pioneering Silverglen Nursery in Durban which has stimulated the establishment of several other nursery ventures countrywide. Besides contributing to germplasm conservation and distribution, medicinal plant nurseries have served as environmental education centres and venues for the transfer of appropriate horticultural skills to traditional medical practitioners. They have received diverse support within the community, so acting as networking nodes linking gatherers, traders, herbalists, commercial nurseries, local government, educational bodies and conservation authorities.

In June 2004, the President of South Africa signed off important new legislation (Act 10), the National Environmental Management: Biodiversity Act. This, in response to the country's CBD obligations, provides for the integrated management and conservation of South Africa's biodiversity, including the sustainable use of plants and the fair and equitable sharing of benefits arising from bioprospecting. Chapter 6 on bioprospecting, access and benefit-sharing has taken cognisance of Article 8(j) of the CBD, which requires that the commercial development of indigenous practices and innovations proceeds with the approval and involvement of the holders of such knowledge. It further requires that benefits arising from such developments are shared equitably with indigenous knowledge holders. The precipitation of a legal framework is a significant achievement, as for the first time in South Africa's history, indigenous knowledge and the related need for sustainable use of plant resources are jointly recognised in law. Monitoring of the status of useful plants is supported by Chapter 3 of Act 10, which addresses biodiversity planning and monitoring elements. The Biodiversity Act is a key foundation from which to address Target 13 of the GSPC in future.

Looking to the future

In the coming months a number of chapters of the Biodiversity Act 10 of 2004 are expected to be regulated: once in place, the full impact of this legislation will become apparent, certainly by 2010. It is anticipated that by this date an Indigenous Knowledge Bill will have been passed, which will further frame the South African research and development (R&D) environment and, it is hoped, contribute to the conservation and reversal of the decline in indigenous and local knowledge, innovations and practices.

An annotated checklist of traditional food subjects of southern Africa is currently in preparation at the National Herbarium and should appear by 2010. That of the ethnomedicinal flora prepared by Arnold *et al.* (2002) is currently being expanded as a web-based product to include plant uses, distribution maps and photographs, besides a brief description.

Recent progress in compiling and interpreting annotated checklists of the useful flora of South Africa will inform a variety of plant conservation projects such as the Millennium Seed Bank Project (MSBP) (see Target 8), which has focused on collecting, *inter alia*, useful plants. A further function of ethnomedicinal compilations is the facilitation of drug discovery programmes. The Department of Science and Technology (DST), through the agency of the National Research Foundation, has provided Innovation Funds to the Novel Drug Development Platform (NDDP) (www.sahealthinfo.org/noveldrug/), a broad-based consortium of South African researchers from clinical and scientific disciplines based in local parastatals, universities and science councils. The object of this research has been to develop new medicines effective against serious and comparatively neglected diseases of the developing world: malaria, tuberculosis and diabetes mellitus. Tonics and immuno-modulatory drugs are further focus areas. Leads for research have often been based on local knowledge of treatments for the diseases considered, and with Chapter 6 of the Biodiversity Act soon to be regulated, equitable sharing of benefits and hence CBD compliance should be effected by the time products reach the marketplace. The work of this consortium is progressing, with a number of promising products moving through the drug development pipeline. Expectations are that on the successful completion of the project at the end of 2006, a number of novel drugs and tonics will have been taken to the point of proof of principle, suitable and ready for early clinical studies, patenting and further development in conjunction with new partners in industry or the World Health Organisation (WHO).



Targeted harvesting of medicinal plants—heavy pressure on remaining resources.
Photograph: Neil R. Crouch



Conservation through propagation—the Pindulwane Medicinal Plant Nursery, Mpumalanga.
Photograph: Neil R. Crouch



Painting stems of *Albizia adianthifolia* to deter harvesting of bark, Silverglen Nature Reserve, Durban.
Photograph: Neil R. Crouch



Fresh leaves of *Kedrostis foetidissima* (Cucurbitaceae), a cucumber-like creeper, form an important food source in the Kalahari.

Photograph: Ben-Erik von Wyk. From: *People's plants—a guide to useful plants of southern Africa*, by Ben-Erik von Wyk & Nigel Gericke, published by Brizo Publications, www.brizo.co.za



Aloe bitters (*Aloe ferox*) are produced on a sustainable basis, using an age-old method of tapping the leaf juice.

Photograph: Pieter Winter. From: *People's plants—a guide to useful plants of southern Africa*, by Ben-Erik von Wyk & Nigel Gericke, published by Brizo Publications, www.brizo.co.za

The substantial local interest in the medicinal flora of the country has led to the unsustainable utilisation of highly sought-after species and consequently threats to their survival. Ironically, by virtue of their popularity, these same taxa make good objects of commercialisation and are the subject of R&D at a number of levels: sustainable harvesting, economics, propagation and farming technologies, chemistry, pharmacology, processing, formulating and packing, marketing and benefit-sharing. Such research will continue. It is expected that the landmark publication of Diederichs (2006) will stimulate the commercialisation of traditional medicines in coming years, and further stimulate R&D and germplasm conservation efforts as financial returns are realised in the local drug development industry.



Dicoma schinzii (Asteraceae), commonly known as maagwortel ('stomach root'), is an important medicine in the Kalahari.

Photograph: Ben-Erik von Wyk. From: *People's plants—a guide to useful plants of southern Africa*, by Ben-Erik von Wyk & Nigel Gericke, published by Brizo Publications, www.brizo.co.za

OBJECTIVE 4: Promoting education and awareness about plant diversity

Making plants relevant to real life

Target 14:

The importance of plant diversity and the need for its conservation incorporated into communication, educational and public-awareness programmes

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Scope

Target 14 emphasises the importance of communication, education and raising public awareness about the importance of plant diversity. The target relates to both formal and informal education at all levels, including primary, secondary and tertiary education. The key target audiences include not only children and other students, but also policy makers and the public in general.

Achievements

South Africa has exceptional biological diversity and a vibrant, active environmental education community. Numerous programmes, partnerships and activities that include a focus on plant diversity and its conservation are in place in South Africa's National Botanical Gardens (NBGs), National Parks and environmental education programmes around the country.

Many thousands of children annually attend learning programmes in the eight NBGs. Recent national lottery funding, specifically for biodiversity learning, has allowed thousands more disadvantaged children to join these programmes. In 2005, 8 505 learners attended educational programmes in the Pretoria NBG alone.

The Outreach Greening Programme of the South African National Biodiversity Institute (SANBI) involves a three-year involvement with schools. The aim is to establish indigenous water-wise gardens at schools. In addition, getting to know the many traditional uses of the wide variety of indigenous plants is a major focus. As part of the process, teachers use indigenous plants to develop lesson plans and integrate their school garden into all learning areas—including mathematics, languages, technology, arts and culture. After two years on the programme, schools are expected to share the benefits of their gardens with their surrounding community. They have to stage an open day, transfer horticultural skills and share the medicinal uses of certain plants. This is particularly necessary in areas where most of the communities depend on traditional plants to treat, for example, HIV/AIDS-related diseases.



Starting young.....the sponsored Kirstenbosch Bus has exposed thousands of visitors, both young and old, to the indigenous plants and associated biodiversity in the Kirstenbosch National Botanical Garden.

Photograph: SANBI



Children from a nearby school exploring the Useful Plants Garden of the KwaZulu-Natal National Botanical Garden, Pietermaritzburg.

Photograph: John Roff

'The culture of valuing biodiversity for the economic benefits it can provide plays an important part in its protection.'

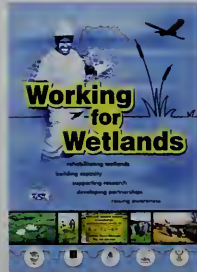
G. Davis, 2005.

Expanded Public Works Programmes

Since the mid-1990s, various environmental projects have been supported by the South African government's Expanded Public Works Programme (EPWP; formerly known as the Special Public Works Programme). The EPWP is a South African government initiative to reduce unemployment. It is a short-term, temporary, labour-intensive programme initiated by government and funded, either fully or partially, from public resources to create a public asset. The programme focuses on targeted groups, namely women, female-headed households, the youth, the disabled and households coping with HIV/AIDS. Empowerment of individuals and communities engaged in EPWP is encouraged through the provision of training.

National environmental expanded public works programmes that have been developed within South Africa include the Working for Water and Working for Wetlands programmes. The Working for Water programme (WfW), initiated in 1995, is a national programme aimed at controlling invasive alien plants, conserving water and promoting social equity through providing jobs and training for economically marginalised people. The WfW programme has created a high degree of public awareness of the value of natural ecosystems, and raised the profile of the problem of invasive alien plants in South Africa. The programme has won 25 national and international awards since it began in 1995. An important impact in poor communities is the general increase in environmental knowledge and awareness gained from training programmes. The environmental spin-offs have the potential to help keep rural areas clear of invasive alien plants, while encouraging sustainable use of natural resources. As part of the WfW programme, the annual South African Weedbuster Week campaign aims to consolidate awareness, support and ownership of the ongoing effort in order to ensure that the invasive alien plant control initiatives in South Africa are effective and sustainable. One of the principal objectives of the campaign is to raise public awareness and understanding about the negative impacts of invasive alien plant species. During Weedbuster Week, events targeting schools, community groups and the general public are organised countrywide in South Africa. The South African campaign is linked bilaterally to invasive plant control initiatives by countries such as Australia and New Zealand, and multilaterally to the broader Global Invasive Species Programme (GISP), whose Secretariat is based at Kirstenbosch National Botanical Garden, South Africa.

The Working for Wetlands programme is a DEAT-funded programme that was transferred to SANBI in January 2003. The programme focuses on the rehabilitation of wetland areas in various parts of South Africa, working closely with DEAT, the Department of Water Affairs and Forestry (DWAF) and the Department of Agriculture (DoA). The programme annually celebrates World Wetlands Day across the country and has been commissioned to complete a national wetland inventory for South Africa.



The Greening of the Nation project, managed by SANBI, is a new DEAT-funded programme that has been initiated in various provinces of South Africa, for community and school greening projects. Activities within this project include the greening of towns (road islands and entrances), schools, crèches, day-care centres, community parks, cemeteries, police stations, cultural villages, as well as the development of community nurseries. Many projects include the development of indigenous gardens as well as vegetable gardens. The programme works in close association with Food & Trees for Africa (FTFA), the first national nongovernment, nonprofit, greening organisation in South Africa, established in 1990. FTFA works in response to community requests and through consultation with community leaders. To raise funding and spread awareness of the many benefits of greening activities, a proactive media campaign is maintained. As part of FTFA's national tree planting programme, it receives applications for trees from underserved communities across South Africa and attempts to provide as many trees as possible through the help of sponsors. Over 2.2 million trees have been distributed to schools, clinics, old age homes, hospices, police stations, streets and parks in this way.



Children IN Distress (CINDI)/SANBI poster showing two medicinal plants and how to use them in primary health care.

Poster: courtesy of CINDI/SANBI



The planting of indigenous trees during Arbor Week has promoted a greater knowledge and awareness, amongst both the general public and politicians alike, of South Africa's floral wealth.

Photograph: SANBI



SANBI's Outreach Greening programme has transformed a number of schools across South Africa and developed a greater appreciation amongst learners of South Africa's indigenous plants.

Photograph: SANBI

Teachers and learners are not familiar with the term 'biodiversity' or 'plant diversity'. The new Revised National Curriculum Statement has a strand dealing with 'biodiversity' in Natural Science and Geography. SANBI's current workshops for teachers make an effort to clarify the concept of 'biodiversity' and 'plant diversity' for the different levels of teaching: foundation phase, intermediate phase and the senior phase.

Useful Plants Gardens

Several of SANBI's NBGs have a Useful Plants/Medicinal Garden, highlighting plants used by most South Africans every day. Valuable educational tools, these gardens are popular with all visitors.

Interpretation Programme

SANBI's innovative interpretation programme brings plant diversity and conservation to life and makes it relevant to all garden visitors. Through methods such as guided theme walks and interpretive signs and labels, visitors receive important messages and information in an appropriate format.

Environmental Calendar Days

National environmental calendar days are widely observed in South Africa. National Arbor Week is particularly prominent, and a focus on plant diversity and its importance is usually taken, especially in SANBI programmes.

Children IN Distress (CINDI)

This active network helping children affected by South Africa's pandemic HIV/AIDS situation, developed an educational poster in conjunction with SANBI. The poster highlights two indigenous plant species that can be easily grown in home gardens, with no additional watering or care. The leaves of these plants are used directly from the plant on various skin conditions that HIV/AIDS sufferers often develop.

National School Curriculum

From South Africa's National Curriculum Statement:

The Revised National Curriculum Statement has tried to ensure that

Botanical Society of South Africa



The Botanical Society of South Africa (BotSoc) was established in the same year as Kirstenbosch National Botanical Garden, in 1913. The Society has 16 branches across the country and produces its regular flagship newsletter, *Veld & Flora* (from

1915 to 1974 known as the *Journal of the Botanical Society of South Africa*), which showcases to its members the Society's involvement in plant conservation and education activities countrywide. It also features stories and horticultural notes on southern Africa's indigenous plants and their uses. Since 1981, the Society has been publishing regional wild flower field guides to the indigenous flora of South Africa and has sold over 100 000 copies to date.

Between 1993 and 2002 BotSoc published a series of Education Posters, with sponsorship from Old Mutual. The goal of this award-winning series was the provision of resource material (the poster and accompanying workbook) on each of South Africa's biomes and it was linked to the school curriculum. It has been estimated that over 5 million learners have used the resource and it continues to be used by South African schools.

Another project championed by BotSoc has been the Water-wise Gardening Campaign, in a partnership between the South African Nursery Association (SANA), Rand Water and the national Department of Water Affairs and Forestry (DWAF). Through this strong partnership, the Society was able to produce resources that highlighted water as a limiting resource, and promote the cause of gardening and landscaping using indigenous plants as a first step in conserving water. Most of South Africa's NBGs have developed water-wise demonstration gardens that share the message about water conservation with visitors.

In 2002, BotSoc started the Conservation Unit (CU) in Kirstenbosch. Since that time the CU has been involved in biodiversity planning, actively integrating biodiversity in land use planning and environmental assessment, developing a range of stewardship options for private land and testing the implementation of these in pilot sites using appropriate incentive measures.

Protea Atlas Project: encouraging amateur involvement

Atlassing projects play an important role in stimulating amateur awareness and enjoyment of natural areas, thus engendering a conservation ethic. One of South Africa's flagship botanical atlassing projects is the Protea Atlas Project (PAP) that started in 1991. Sponsored by SANBI, the University of Cape Town (UCT), the Mazda Wildlife Fund, the Department of Environmental Affairs and Tourism (DEAT), Botanical Society of South Africa and the World Wide Fund for Nature, South Africa (WWF-SA), the project relied on volunteer atlassers who sent in their personal observations in the form of site record sheets on the distribution of proteas. The response to the project from amateurs was very encouraging with a few atlassers submitting more than 2 000 Sight Record Sheets. Since the project started, eight new species of proteas have been discovered by atlassers and the distribution ranges of over one third of South Africa's proteas have been extended. It has been estimated that about one third of South Africa's proteas are in danger of extinction. By December 2001, 250 000 records of 377 proteas from 57 500 localities had been submitted to the project by over 480 atlassers, making it one of the premier plant databases in the world.

Urban Conservation: engaging with communities

Urban Conservation is a unit of SANBI, based at Kirstenbosch, that focuses on projects and partnerships 'beyond the garden fence' that look at biodiversity conservation from a community development perspective. The Urban Conservation Programme aims to:

- Build public understanding of the biodiversity value in threatened urban environments.
- Facilitate people's involvement in biodiversity-related action, especially the youth and poorer communities.
- Engage in actions leading to protection and restoration of ecosystems threatened by urban activities.
- Contribute to processes and partnerships that improve urban environmental management practice.

The flagship project of Urban Conservation is Cape Flats Nature which was started in July 2002 as a partnership between the City of Cape Town, SANBI, the Table Mountain Fund (WWF-SA) and the Botanical Society of South Africa under the banner of C.A.P.E. This partnership attempts to build good practice in the sustainable management of fragmented natural habitats in the City of Cape Town's Biodiversity Network in a people-centred way that develops local leadership for conservation action and benefits the surrounding communities. Communities that particularly benefit from this programme are townships where incomes are low and living conditions poor. Cape Flats Nature catalyses on-the-ground conservation management that involves the surrounding communities in preserving the area's natural heritage for future generations. The programme also catalyses access to outdoor classrooms for curriculum-based environmental education and awareness-raising on the doorstep of learners from poor communities. Cape Flats Nature's home is the Edith Stephens Wetland Park (ESWP) on the Cape Flats, a 40 ha piece of land jointly owned by SANBI and the City of Cape Town. Also home to Working for Wetlands (Western Cape) and the Western Cape Primary Science Programme, the ESWP and its associated organisations provide services to surrounding communities, from job creation and youth development to support and training of educators. The ESWP is one of four pilot sites of Cape Flats Nature.

all Learning Area Statements reflect the principles and practices of social justice, *respect for the environment* and human rights as defined in the Constitution [of South Africa].

Durban Parks Department

Silverglen Medicinal Plant Nursery has been running educational programmes for traditional healers, who are the largest exploiters of many medicinal plant species in South Africa's KwaZulu-Natal Province. Programmes encourage healers to grow their own plants and teach them practical techniques for doing this.

Private Sector Environmental Education (EE)

'... two organisations took a plant-related focus, with Table Mountain National Park (TMNP) focusing on fynbos biodiversity and schools environmental education and development on indigenous knowledge of healing plants. One of the days was a field trip, during which TMNP introduced teachers to fynbos, and SEED visited township schools that have developed food gardens, medicinal gardens and nurseries. That group planted a medicinal garden at their college that day.'—Ally Ashwell of Enviroeds, describing part of a teacher's programme developed with a range of partners.

Wildlife and Environment Society of South Africa

This NGO has been running environmental education programmes for children in South Africa for over 30 years. Many include plant conservation.

'... each plant is discussed in terms of its palatability and suitability as food for animals... This is made relevant to learners by relating each grass species to food types with which they are familiar. For example, Turpentine Grass is put in a group of food which the learners do not like (the general response is something like spinach!), and a good grazing grass you would group with foods they do like (usual responses include pizza etc...).—Activity from the Society's Environmental Education Programme.

Champion Trees

In an effort to raise public awareness about South Africa's national tree heritage, and to promote it as an asset to tourism, the national Department of Water Affairs and Forestry (DWAF) has launched the Champion Tree Project of South Africa. The Project is aimed at identifying and protecting individual trees of national conservation importance under the National Forests Act of 1998. Trees, either indigenous or exotic, can be nominated on the basis of their size, age, aesthetic value, cultural-historic value or importance for tourism. Once listed as protected via the Government Gazette and newspapers, Champion Trees will have special protected status and no such trees may be cut, disturbed or damaged without a licence granted by DWAF (or a delegated authority). Additional protection measures, such as fenced enclosures, may be necessary for some trees.

Delta Park Environmental
Education Centre

A well-established and very busy environmental education centre in Johannesburg, Delta's programmes for children and adults include a sensory trail, water-wise gardening, Arbor Day, medicinal and herbal plants, and alien plants (including practical removal). They partner with the University of the Witwatersrand to research removal methods for the alien invasive water hyacinth, a project with global importance for plant conservation.

Book Publishers

Several South African publishers produce books that are directly relevant—Struik, Briza Publications, Jacana, Umदाus Press, the Botanical Society of South Africa and Fernwood Press in particular have released various field guides and titles on South Africa's indigenous, medicinal, poisonous and useful plants. These books are widely read and used in South Africa.

Promoting South Africa's trees



The annual Trees-of-the-Year posters developed by SANBI are distributed to schools and used to promote a greater understanding of both a common and rare indigenous tree every year.

National Arbor Week (known as Arbor Day between 1983 and 1998) is traditionally celebrated in South Africa from 1 to 7 September (spring) each year. Many government, NGO and parastatal organisations use this week to promote an awareness and better understanding, particularly amongst schools and learners, of the value of South Africa's indigenous trees to society (South Africa has 1 700 tree species of which 47 are protected). Many programmes are held country-wide during the week, and schools, businesses and organisations are encouraged to participate in community 'greening' events to (a) improve the health and beauty of the local environment and (b) promote a green future for South Africa. Accompanying Arbor Week is a parallel programme, the Trees-of-the-Year Programme, that highlights two indigenous trees, one common and the other rare, each year. Many nurseries propagate thousands of these trees for schools and municipalities to plant out during Arbor Week. Posters promoting the Trees of the Year are developed annually by SANBI and made available to schools for use in their environmental education programmes. In 2005, as part of the Arbor Week celebrations, over 12 000 trees were sponsored and planted during events held in schools, prisons, parks, municipalities and other community areas.



Interpretive storyboards in South Africa's National Botanical Gardens promote an understanding of the uses, conservation status and distribution of South Africa's indigenous plants.



Ex situ collections in South Africa's National Botanical Gardens are used to create a greater awareness and understanding of plant-animal interactions and the diversity of South Africa's indigenous plants.

Photograph: Isabel Johnson



South Africa's National Botanical Gardens host thousands of learners through structured environmental education programmes every year.

Photograph: SANBI

Gardens of Pride



A recent private-public partnership that has promoted indigenous plants in South Africa is the national Pam Golding Properties *Gardens of Pride Competition*, held annually in association with ABSA Home Loans and SANBI. This increasingly popular competition seeks to promote the use of indigenous plants—and water-wise gardening methods—in individual, school and community gardens to foster pride in gardens and encourage the greening of communities in South Africa. The competition, with various prizes attached, incorporates several metropolitan areas around South Africa. A new category catering for individual and community township gardens has recently been included in the competition. The competition has three sections: for homeowners with both large (500 m²) and small (under 500 m²) gardens, for individual and/or community gardens situated in townships (any size) and for schools involved in SANBI's Outreach Greening programme in Gauteng and the Western Cape Provinces. For the homeowners' category the gardens must have at least a 70% indigenous plant content and for township gardens an indigenous plant content of 40% is required.

Looking to the future

Faced with rising levels of exploitation of South Africa's plant diversity and natural systems, the efforts described above have to be intensified. In particular, programmes for the general public should grow in scope and effect. Government policy makers need far greater awareness and information on plant diversity issues—lobbying may be an effective method here. Tertiary education institutions should include biodiversity issues and awareness as part of a basic grounding curriculum for all students. There is much activity in terms of the target, but measurement and evaluation of real change on the ground is weak. This needs investment of time and energy from committed people and organisations.

OBJECTIVE 5: Building capacity for the conservation of plant diversity

Training in plant conservation

Target 15:

The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this strategy

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Scope

While education broadens the mind, training focuses the mind. Training produces individuals with specialist skills that empower them to add value through their own work and through the transfer of such skills to colleagues in the workplace. To maximise outputs from training, appropriate facilities—herbaria, laboratories, field equipment and vehicles—are needed. Target 15 is considered as one of the four cross-cutting targets of the GSPC and as such should be relevant to all other targets listed in the GSPC, such as training of taxonomists and systematists, Red List officers, horticulturists, conservation officers, officials monitoring plant trade and all people required to support the implementation of the GSPC.

Achievements

During the 1990s, the facilities and human capacity of many conservation institutions in South Africa and the region declined significantly. However, the establishment of the GEF/UNDP- and USAID/IUCN ROSA-funded SABONET capacity-building project provided a major boost to training and facilities in ten southern African countries, including South Africa. The primary focus was on plant taxonomy and herbarium facilities, but training courses included Red Data listing, Important Plant Areas, Environmental Impact Assessments, *ex situ* conservation of threatened species and identification of CITES species (such as cycads) by field officers. The 29 regional training courses afforded 220 southern African botanists an opportunity to develop specialised skills of direct relevance to plant conservation.

SABONET leaves an important legacy, not only in the specialists it trained, but also in a vastly expanded electronic database on the flora (1 200 000 specimens of 30 000 taxa), regional and national checklists for all ten countries, Red Data Books and other plant conservation inventories, and a new cohort of horticulturists. The ongoing indigenous plant horticultural training at Kirstenbosch and the seven other SANBI National Botanical Gardens, and initiatives such as Green Futures in the private sector, have introduced a rapid



Training courses, such as this course on aquatic plant identification, formed an integral part of the GEF/UNDP-funded SABONET Project.

Photograph: Christopher K. Willis



Learning by doing. Practical exercises were emphasised in all SABONET-hosted training courses.

Photograph: Christopher K. Willis



Biodiversity lectures are often presented to community members at the Edith Stephens Wetland Park, Western Cape.

Photograph: SANBI



Community fire-fighting workshop in the Cape Flaristic Region.

Photograph: SANBI



Fieldwork forms an essential component of efforts to understand and conserve South Africa's plants *in situ*.

Photograph: SANBI



The Leslie Hill Molecular Systematics Laboratory at Kirstenbosch hosts a number of students working on molecular systematics research projects each year.

Photograph: SANBI



The Edith Stephens Wetland Park is often used as an outdoor classroom for environmental education activities by surrounding schools.

Photograph: SANBI

Green Futures Horticulture and Life Skills College



Based at Grootbos Private Nature Reserve in the Western Cape, the Green Futures Horticulture and Life Skills College (www.greenfutures.co.za) opened in 2003 and is committed to building sustainable livelihoods through nature-based education.

Each year twelve students from nearby townships are selected to participate in their horticulture, landscaping and life skills course. Most have no prior knowledge of indigenous plants, but within a year they are brimming with enthusiasm and ready to put their new knowledge and skills to work. The course combines essential life skills like personal finance, business skills, driving and health education, with knowledge of environmental and conservation issues, and skills of horticulture and landscaping. Classroom sessions, practical involvement in nursery and landscaping projects, and field trips to interesting places make learning relevant, stimulating and fun. Already two groups of students have graduated from this exciting programme. What is most encouraging is that all Green Futures graduates have either been snapped up by employers or, in one notable case, opted for self-employment.



Students from Green Futures Horticulture and Life Skills College.

Photographs: Seon D.J. Privett

Seed funding to establish the Green Futures College was donated by the German Development Bank (DEG), which matched an investment by Grootbos Private Nature Reserve on a rand-for-rand basis. In terms of the original grant, Green Futures was expected to become self-funding after two years. This was the incentive for some creative thinking that resulted in the college building economic sustainability into the design of its courses.

All students spend about 30% of their time at college working in the Green Futures plant nursery and assisting with fynbos water-wise landscaping projects. This not only provides them with essential practical experience but also enables them to generate funds through the sale of plants and provision of landscaping services. These earnings are invested in the Grootbos Green Futures Foundation, which helps to finance students attending the following year's course.



Group work sessions at the Green Futures Horticulture and Life Skills College.

Photograph: Seon D.J. Privett

and substantial transformation in the profession.

The training of underprivileged communities, farmers and other landowners to participate and serve as volunteers in the Custodians of Rare and Endangered Wildflowers (CREW) Project plays an important role in plant conservation within South Africa. Started initially in the priority threatened plant areas of the Western and southern Cape, the planned expansion of this programme to the northern provinces of South Africa in 2006 should significantly improve the collection of field data used for Red List assessments and the monitoring of threatened plant populations.

Looking to the future

Despite the impact of SABONET, the region still suffers from a dearth of taxonomists in most taxonomic groups, most especially in the bryophytes, fungi and algae. The establishment of SANBI in 2004, with a specific parliamentary mandate to promote taxonomic study of all groups (including animals), offers new opportunities. A detailed national audit of the state of systematics in South Africa, and the capacity needs to meet the mandate of the Biodiversity Act, is in progress.

Many opportunities still exist for volunteers to become involved, through multisectoral partnership programmes such as CREW, with the *in situ* monitoring and conservation of South Africa's indigenous flora (particularly threatened and endemic plant taxa).

SANBI: building South Africa's plant conservation capacity



Horticultural students at Kirstenbosch. Photograph: SANBI

As the single largest employer of botanists within the country, and focused on the research, documentation, cultivation, education and conservation of South Africa's indigenous flora (and fauna), the South African National Biodiversity Institute (SANBI) is engaged in ongoing training and capacity-building of its staff. Since 2000, 44 staff have been supported for both undergraduate and postgraduate (Honours, Masters and PhD) studies. In the Gardens Directorate, the following studentships of varying duration have been offered to horticultural students: 86 six-month studentships, 14 two-year studentships and four Kirstenbosch Scholarships. The Kirstenbosch Scholarship, of one-year duration, is provided to qualified horticulturists with a special aptitude for botany and research work connected with South Africa's indigenous flora. Within the Research Directorate, eight MSc bursaries have been granted by SANBI since 2000, and 42 undergraduate interns have been supported for a period of three months.

Horticultural skills training of staff within the Gardens Directorate has reached 236 SANBI staff since 2000. Courses offered as part of this training have included botanical gardens maintenance, commercial plant production, alien vegetation removal, horticultural equipment and tree work. In line with legislation regulating training in South Africa, these courses are nationally registered and offered by accredited training providers.



The C.A.P.E. Partners' Conference provides an ongoing forum for the exchange of lessons learnt regarding the conservation and sustainable use of the Cape Floristic Region.

Photograph: Cape Action for People and the Environment



Conservation of the Cape Floristic Region at the landscape level involves conservation stewardship in the matrix of habitat fragments among agricultural land uses.

Photograph: David Rogers



Annual Biodiversity Planning and Implementation Forum in the uKhahlamba Drakensberg Park World Heritage Site. The Forum was established in 2004 to provide an opportunity for individuals, agencies and departments involved in spatial biodiversity planning to share and synthesise valuable lessons learnt from biodiversity programmes in southern Africa.

Photograph: SANBI

OBJECTIVE 5: Building capacity for the conservation of plant diversity

Learning networks for effective plant conservation at the bioregional scale

Target 16:

Networks for plant conservation activities established or strengthened at national, regional and international levels

Trevor Sandwith

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Scope

The rationale for the establishment and maintenance of networks is that they enhance communication and co-ordination and provide a mechanism for the exchange of information, lessons learnt and technology. Conservation networks are formed for a variety of reasons, including for research collaboration, co-ordinated implementation of conservation strategies, sharing and dissemination of knowledge, joint problem-solving and strategy formulation. If managed effectively, they can ensure integration among relevant economic and government sectors, collaboration between governmental and non-governmental organisations, as well as the integration of policies, strategies and on-the-ground implementation.

Target 16 is cross-cutting, and relevant organisations that support the Global Strategy for Plant Conservation are encouraged to establish networks to address many of the other strategic targets. Implicit in this are some of the key challenges of networks. The rationale for their establishment appears obvious, yet as with any partnership, the strength of the network depends on the relative costs and benefits for all of those involved in their ongoing maintenance. The most effective networks are those that are essential for the effective achievement of a well-established objective, strategy or action plan, and especially where there is institutional commitment and value in managing and participating in the network.

A key challenge for the achievement of this target is that it is imprecise in its formulation, and the responsibility for achieving it is unspecific. Nevertheless, the development of networks for plant conservation in Africa has been fuelled by a genuine need for collaboration among countries with widely varying approaches and capacities, and a sincere desire among countries in the region to contribute to learning and supporting regional efforts to achieve global and national goals. The development of networks in the region has been considerably enhanced by the investment in regional conservation programmes and associated networks by the Global Environment Facility and by leading international conservation NGOs active in the region.

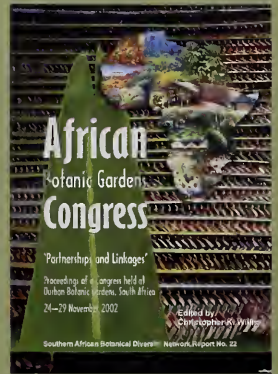
Achievements

Since the transition to democracy in South Africa, South African conservation institutions have been able to develop links with other organisations in the region and to establish several regional conservation networks for plant conservation. These have been enabled through the work of the Southern African Development Community (SADC) and the various sectoral portfolios

that it promotes. Prominent among these is the Southern African Botanical Diversity Network (SABONET). This GEF/UNDP-funded project, managed and administered by SANBI, was co-financed by USAID and IUCN ROSA and involved 10 southern African countries, namely Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. Its primary objective was to build a strong core of professional botanists, taxonomists and horticulturists and plant diversity specialists within the 10 countries. Among its many products were a report series and newsletters, sponsored training of 26 students, two regional expeditions, funded collecting trips in each country, computerised herbarium records, workshops and training courses. Successfully implemented, it is likely that those involved will continue to contribute to the many national, regional and international plant conservation programmes that will be built on SABONET foundations. Maintaining the network across the full set of networked partners has not been possible, however, as an ongoing source of funding was not available.

SANBI was also involved in establishing the African Botanic Gardens Network (ABGN), with an initial conference held in Durban, South Africa, in 2002. The network supports the work of botanical gardens and associated institutions through education, conservation and sustainable use of plants for development, poverty alleviation and halting biodiversity loss. With a broad mandate, the ABGN developed an action plan with clear targets linked to the Global Strategy for Plant Conservation, and specific institutional and governance mechanisms, involving an assembly of members, a steering committee, secretariat and co-ordinator.

It is perhaps in the arena of bioregional conservation networks that southern African institutions have made the greatest strides with strategic implementation of the ecosystem approach for plant conservation in the region. Co-operative scientific programmes initiated in South Africa in the 1980s led to the development of innovative research programmes such as the Grasslands Biome project and the Fynbos Biome project. Their legacy was not only science and baseline information for analysing and improving conservation practice, but also forums of interest in biome-wide science, policy and implementation. Once such network, the Fynbos Forum, focussed on the Cape Floristic Region, is an entirely voluntary network of scientists and managers that meets annually to share the results of research and experience and to identify strategic opportunities for networking and collaboration. With support from the National Research Foundation (NRF) and supported by the Botanical Society of South Africa, the Fynbos Forum has resulted in several highly innovative plant conservation programmes. These include the Working for Water programme that identified that the removal of alien plants would not only enhance biodiversity conservation, but would result in better water yields from catchment areas and enhance employment and entrepreneurial opportunities. Secondly, the combination of scientific and management expertise represented in the network resulted in the development of one of the world's most progressive bioregional conservation programmes, known as Cape Action for People and the Environment (C.A.P.E.). C.A.P.E. has become a governed network of conservation projects and activities that stretches across the whole of the Cape Floristic Region and invests in the consolidation and maintenance of conservation corridors involving state and private land, the protection through conservation stewardship of fragmented and threatened habitats in critical lowland sites, institutional strengthening and capacity-building, as well as the mainstreaming of biodiversity into social and economic development programmes in the region. SANBI acts as the Programme Management Agency for C.A.P.E. and is also a key implementation partner, through its threatened plants programme, conservation farm-



Proceedings of the inaugural African Botanic Gardens Congress, published simultaneously in French and English.



Inaugural congress of the African Botanic Gardens Network held at the Durban Botanic Gardens, November 2002. The meeting was attended by 67 delegates representing 23 African countries.
Photograph: African Botanic Gardens Network



Strong camaraderie developed between course participants and lecturers during the various SABONET training interventions. The motto 'learning by doing' was adopted for the duration of the SABONET Project.

Photograph: Christopher K. Willis



Local action by community partners contributes towards management strategies for threatened plants in the Cape Floristic Region.

Photograph: Xola Mkefe

ing and urban conservation activities. In many ways C.A.P.E. epitomises a network that has graduated into a comprehensive conservation programme, while maintaining strongly networked partners, committed to a programme of implementation and executed through a range of agreements and partnerships. The development of C.A.P.E. was also instrumental in the evolution of the former National Botanical Institute (NBI) into SANBI, whose new mandate includes bioregional conservation programmes and biodiversity information in a managed network model of institutions. SANBI has also become a focal point for the development of other bioregional programmes, including the Succulent Karoo Ecosystem Programme (SKEP), the Subtropical Thicket Ecosystem Programme (STEP) and the Grasslands Programme. Key to the development of these initiatives by SANBI has been the investment of funding by the Global Environment Facility, supported by the World Bank and UNDP as well as the Critical Ecosystem Partnership Fund (CEPF) that have created the incentive and conditions for leveraging substantial in-country resources and commitment.

Knowledge-networking within and between these programmes has emerged strongly and the programmes, while developing their own processes for learning and exchanging lessons through workshops, conferences, e-news, working groups and task teams, have also led to the establishment of a national forum for bioregional conservation programmes.

Building upon the rich legacy of the Co-operative Scientific Programmes, SANBI is also negotiating with the Southern African Environmental Observatory Network (SAEON) to host the Fynbos Node. The SAEON Fynbos Node will act as a network to co-ordinate research into the Fynbos Biome, across the natural and social sciences, to enhance the understanding of ecosystem structure and functioning, capacity-building and information management.

Where programmes have extended across the boundaries of states in the region, transboundary conservation programmes have emerged to cater for the specific needs of collaboration and co-operation across national boundaries. SANBI has become a networking hub for the region and internationally, with the Chair of the IUCN Species Survival Commission based in SANBI's Rufford-Maurice Laing Centre for Biodiversity Conservation at Kirstenbosch, which is also home to the Deputy-Chair of the IUCN World Commission on Protected Areas, the IUCN Task Force on Transboundary Conservation, whose Global Network for Transboundary Conservation is hosted there, Conservation International's Transboundary Conservation Unit, and the Global Invasive Species Programme (GISP). The Centre therefore acts as a remarkable hub for networking in the subregion and for learning about how networks can be managed and sustained as a product of institutional partnerships for plant conservation.

Looking to the future

To meet its obligations for Target 16, South Africa must elaborate more specific objectives that relate to the target. In particular these will be concerned with the comprehensiveness and appropriateness of multi-agency, multiple-level co-ordination networks for research, science and policy development, and for the strategic implementation of large-scale and targeted conservation programmes. Key requirements for the future will be to achieve an understanding of how network governance supports and enhances co-ordination, co-operation and effectiveness. Governance principles and good governance in practice must be analysed, understood and promoted. In addition, since conservation programmes are targeted and purposeful, effective systems for integrating knowledge and for measurement, monitoring and evaluation of progress towards programme goals must be established.

References and Further Reading

Introduction

ANDERSON, J.M. (ed.) 1999. *Towards Gondwona Alive: promoting biodiversity and stemming the Sixth Extinction*. Gondwona Alive Society, Pretoria.

ANDERSON, J.M. & ANDERSON, H.M. 2003. Heyday of the gymnosperms: systematics and biodiversity of the Late Triassic Molteno fructifications. *Strelitzia* 15. National Botanical Institute, Pretoria.

ANDERSON, J.M., ANDERSON, H.M. & CLEAL, C. In prep. A brief history of the gymnosperms: classification, biodiversity, phytogeography and ecology. *Strelitzia*. SANBI, Pretoria.

ARNOLD, T.H., PRENTICE, C.A., HAWKER, L.C., SNYMAN, E.E., TOMALIN, M., CROUCH, N.R. & POTTAS-BIRCHER, C. 2002. Medicinal and magical plants of southern Africa: an annotated checklist. *Strelitzia* 13. National Botanical Institute, Pretoria.

BOLTON, J.J. & ANDERSON, R.J. 1997. Marine vegetation. In R.M. Cowling, D.M. Richardson & S.M. Pierce (eds), *Vegetation of southern Africa*: 348–370. Cambridge University Press, Cambridge.

BRANCH, G. & BRANCH, M. 1985. *The living shores of southern Africa*. C. Struik Publishers, Cape Town.

BRUTON, M.N. & COOPER, K.H. (eds) 1980. *Studies on the ecology of Moputaland*. Rhodes University, Grahamstown and Natal Branch of the Wildlife Society of Southern Africa, Durban.

BURGOYNE, P.M., VAN WYK, A.E., ANDERSON, J.M. & SCHIRE, B.D. 2005. Phanerozoic evolution of plants on the African plate. *Journal of African Earth Sciences* 43: 13–52.

COWLING, R.M. & HOLMES, P.M. 1992. Endemism and speciation in a lowland flora from the Cape Floristic Region. *Biological Journal of the Linnean Society* 47: 367–383.

COWLING, R.M. & RICHARDSON, D. 1995. *Fynbos: South Africa's unique floral kingdom*. Fernwood Press, Vlaeberg.

COWLING, R.M., RICHARDSON, D.M. & PIERCE, S.M. (eds) 1997. *Vegetation of southern Africa*. Cambridge University Press, Cambridge.

ESTERHUYSE, N., VON BREITENBACH, J. & SÖHNKE, H. 2001. *Remarkable trees of South Africa*. Briza Publications, Pretoria.

GERMISHUIZEN, G. & MEYER, N.L. (eds) 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.

GIVEN, D.R. 1990. Conserving botanical diversity on a global scale. *Annals of the Missouri Botanical Garden* 77: 48–62.

GIVEN, D.R. 1994. *Principles and practice of plant conservation*. Chapman & Hall, London.

HÄNEL, C., CHOWN, S.L. & GASTON, K.J. 2005. *Gough Island: a natural history*. Sun Press, Stellenbosch.

HELME, N. & TRINDER-SMITH, T. 2005. The endemic flora of the Cape Peninsula. *Veld & Flora* 91,3: 114–117.

HUNTLEY, B.J. (ed.) 1994. Botanical diversity in southern Africa. *Strelitzia* 1. National Botanical Institute, Pretoria.

LAWES, M.J., EELEY, H.A.C., SHACKLETON, C.M. & GEACH, B.G.S. (eds) 2004. *Indigenous forests and woodlands in South Africa: policy, people and practice*. University of KwaZulu-Natal Press, Scottsville.

LUBKE, R.A., AVIS, A.M., STEINKE, T.D. & BOUCHER, C. 1997. Coastal vegetation. In R.M. Cowling, D.M. Richardson & S.M. Pierce (eds), *Vegetation of southern Africa*: 300–321. Cambridge University Press, Cambridge.

MANNING, J., GOLDBLATT, P. & SNIJMAN, D. 2002. *The Color Encyclopedia of Cape bulbs*. Timber Press, Portland.

MIDGLEY, G.F., RUTHERFORD, M.C. & BOND, W.J. 2001. *The heat is on—impacts of climate change on plant diversity in South Africa*. National Botanical Institute, Cape Town.

MUCINA, L., RUTHERFORD, M.C. & POWRIE, L.W. (eds) 2005. *Vegetation Map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps*. South African National Biodiversity Institute, Pretoria.

MYERS, N. 1990. The biodiversity challenge: expanded hot-spot analysis. *The Environmentalist* 10: 243–256.

PAUW, A. & JOHNSON, S. 1999. *Table Mountain: a natural history*. Fernwood Press, Vlaeberg.

- SCHOLES, R.J. 2004. Woodlands of South Africa. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 3–29. University of KwaZulu-Natal Press, Scottsville.
- SMITH, G.F., CHESSELET, P., VAN JAARSVELD, E.J., HARTMANN, H., HAMMER, S., VAN WYK, B-E., BURGOYNE, P., KLAK, C. & KURZWEIL, H. 1998. *Mesemb of the world*. Briza Publications, Pretoria.
- VAN JAARSVELD, E., VAN WYK, B-E. & SMITH, G. 2000. *Succulents of South Africa. A guide to the regional diversity*. Tafelberg Publishers, Cape Town.
- VAN WYK, A.E. & SMITH, G.F. 2001. *Regions of floristic endemism in southern Africa. A review with emphasis on succulents*. Umdaus Press, Hatfield.
- VAN WYK, B-E. & GERICKE, N. 2000. *People's plants. A guide to useful plants of southern Africa*. Briza Publications, Pretoria.
- VAN WYK, B-E., VAN OUDTSHOORN, B. & GERICKE, N. 1997. *Medicinal plants of South Africa*. Briza Publications, Pretoria.
- WALKER, C. & DU P. BOTHMA, J. 2005. *The soul of the Waterberg*. African Sky Publishing, Houghton.
- WILLIAMSON, G. 2000. *Richtersveld: the enchanted wilderness*. Umdaus Press, Hatfield.
- WILLIS, C.B. 2004. Policy frameworks pertaining to the conservation and sustainable use of forests and woodlands in South Africa. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 77–107. University of KwaZulu-Natal Press, Scottsville.
-
- Target 1: A widely accessible working list of known plant species, as a step towards a complete world flora**
-
- ALBERS, F. & MEVE, U. (eds) 2002. *Illustrated handbook of succulent plants: Asclepiadaceae*. Springer-Verlag, Berlin.
- ARNOLD, T.H. & DE WET, B.C. (eds) 1993. Plants of southern Africa: names and distribution. *Memoirs of the Botanical Survey of South Africa*. No. 62. National Botanical Institute, Pretoria.
- ARNOLD, T.H., PRENTICE, C.A., HAWKER, L.C., SNYMAN, E.E., TOMALIN, M., CROUCH, N.R. & POTTAS-BIRCHER, C. 2002. Medicinal and magical plants of southern Africa: an annotated checklist. *Strelitzia* 13. National Botanical Institute, Pretoria.
- DOIDGE, E.M. 1950. The South African fungi and lichens to the end of 1945. *Bothlio* 5: 1–1094.
- EGGLI, U. (ed.) 2001. *Illustrated handbook of succulent plants: monocotyledons*. Springer-Verlag, Berlin.
- EGGLI, U. (ed.) 2002. *Illustrated handbook of succulent plants: dicotyledons*. Springer-Verlag, Berlin.
- GERMISHUIZEN, G. & MEYER, N.L. (eds) 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y. & KEITH, M. (eds) 2006. A checklist of South African plants. *Southern African Botanical Diversity Network Report* No. 41. SABONET, Pretoria.
- GIBBS RUSSELL, G.E., REID, C., VAN ROOY, J. & SMOOK, L. 1985. List of species of southern African plants. Part 1. Cryptogams, gymnosperms and monocotyledons. *Memoirs of the Botanical Survey of South Africa* No. 51. Botanical Research Institute, Pretoria.
- GIBBS RUSSELL, G.E., WATSON, L., KOEKEMOER, M., SMOOK, L., BARKER, N.P., ANDERSON, H.M. & DALLWITZ, M.J. 1990. Grasses of southern Africa. An identification manual with keys, descriptions, distributions, classification and automated identification and information retrieval from computerized data. *Memoirs of the Botanical Survey of South Africa*. No. 58. Botanical Research Institute, Pretoria.
- GIBBS RUSSELL, G.E., WELMAN, W.G., RETIEF, E., IMMELMAN, K.L., GERMISHUIZEN, G., PIENAAR, B.J., VAN WYK, M. & NICHOLAS, A. 1987. List of species of southern African plants. Part 2. Dicotyledons. *Memoirs of the Botanical Survey of South Africa* No. 56. Botanical Research Institute, Pretoria.
- GIBBS RUSSELL, G.E., GERMISHUIZEN, G., HERMAN, P., OLIVIER, P., PEROLD, S.M., REID, C., RETIEF, E., SMOOK, L., VAN ROOY, J., WELMAN, W.G. 1984. List of species of southern African plants. *Memoirs of the Botanical Survey of South Africa* No. 48. Botanical Research Institute, Pretoria.
- GLEN, H.F. 2002. *Cultivated plants of southern Africa—names, common names, literature*. Jacana, Johannesburg.
- GLEN, R., ARCHER, C. & VAN ROOY, J. 1999. Aquatic plants of southern Africa. In G.I. Cowan (ed.), *Biota of South African wetlands in relation to the Ramsar Convention*: 5–22. Department of Environmental Affairs and Tourism, Pretoria.

- HARTMANN, H.E.K. (ed.) 2001a. *Illustrated handbook of succulent plants: Aizoaceae A–E*. Springer-Verlag, Berlin.
- HARTMANN, H.E.K. (ed.) 2001b. *Illustrated handbook of succulent plants: Aizoaceae F–Z*. Springer-Verlag, Berlin.
- MAGILL, R.E. & SCHELPE, E.A. 1979. The bryophytes of southern Africa. An annotated checklist. *Memoirs of the Botanical Survey of South Africa*. No. 43. Botanical Research Institute, Pretoria.
- PHILLIPS, E.P. 1926. A preliminary list of the known poisonous plants found in South Africa. *Botanical Survey Memoir* No. 9. Department of Agriculture, Pretoria.
- SEAGRIEF, S.C. 1984. A catalogue of South African green, brown and red marine algae. *Memoirs of the Botanical Survey of South Africa*. No. 47. Botanical Research Institute, Pretoria.
- SMITH, C.A. 1966. Common names of South African plants. *Memoirs of the Botanical Survey of South Africa*. No. 35. Botanical Research Institute, Pretoria.
- SMITH, G.F. 1996. The Species Plantarum Project—a world Flora in the making. *South African Journal of Science* 92: 171, 172.
- SMITH, G.F. 1997. Progress with the Species Plantarum Project. *South African Journal of Science* 93: 387, 388.
- SMITH, G.F. 1998. *Species plantarum*. *Flora of the world*. Can southern African systematists contribute? *SABONET News* 3: 29–31.
- SMITH, G.F. 1999a. Documenting plant diversity on a global scale: recent progress with the Species Plantarum: Flora of the world project. *South African Journal of Science* 95: 55, 56.
- SMITH, G.F. 1999b. Recent progress with the Species Plantarum: Flora of the world project. *SABONET News* 4: 52–54.
- SMITH, G.F. 2000. Further developments in the Species Plantarum: Flora of the World project. *South African Journal of Science* 96: 482, 483.
- SMITH, G.F. 2002. The Species Plantarum Project: Flora of the World moves ahead. *South African Journal of Science* 98: 28.
- SMITH, G.F. In press. Progress on the Species Plantarum Programme—Flora of the World at the International Botanical Congress in Vienna. *South African Journal of Science* 101.
- SMITH, G.F., VAN JAARSVELD, E.J., ARNOLD, T.H., STEFFENS, F.E., DIXON, R.D. & RETIEF, J.A. (eds) 1997. *List of southern African succulent plants*. Umदाus Press, Pretoria.
- SMITH, G.F. & WOLFSON, M.M. 2004. Mainstreaming biodiversity: the role of taxonomy in bioregional planning activities in South Africa. *Taxon* 53: 467, 468.
- WELLS, M.J., BALSINHAS, A.A., JOFFE, H., ENGELBRECHT, V.M., HARDING, G. & STIRTON, C.H. 1986. A catalogue of problem plants in southern Africa, incorporating the National Weed List of South Africa. *Memoirs of the Botanical Survey of South Africa*. No. 53. Botanical Research Institute, Pretoria.

Target 2: A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels

- DAVIS, S.D., DROOP, S.J.M., GREGERSON, P., HENSON, L., LEON, C.J., VILA-LOBOS, J.L., SYNGE, H. & ZANTOVSKA, J. 1986. *Plants in danger: what do we know?* IUCN, Gland.
- GOLDING, J. (ed.) 2002. Southern African Plant Red Data Lists. *Southern African Botanical Diversity Network Report* No. 14. SABONET, Pretoria.
- HALL, A.V. & VELDHIJS, H.A. 1985. *South African Red Data Book: plants—Fynbos and Karoo Biomes*. South African National Scientific Programmes Report 117: 1–160. Foundation for Research Development, Pretoria.
- HALL, A.V., DE WINTER, M., DE WINTER, B. & OOSTERHOUT, S.A.M. 1980. *Threatened plants of southern Africa*. South African National Scientific Programmes Report 45: 1–244. Council for Scientific and Industrial Research, Pretoria.
- HILTON-TAYLOR, C. 1996. Red Data List of southern African plants. *Strelitzia* 4. National Botanical Institute, Pretoria.
- IUCN RED LIST OF THREATENED SPECIES. 2005. <http://www.redlist.org/search/search-basic>. Last updated 11 December 2005.
- SCOTT-SHAW, R. 1999. *Rare and threatened plants of KwaZulu-Natal and neighbouring regions*. KwaZulu-Natal Nature Conservation Service, Pietermaritzburg.

VICTOR, J.E. 2002. South Africa. In J. Galding (ed.), *Southern African plant Red Data Lists*. Southern African Botanical Diversity Network Report Series 14: 93–120. SABONET, Pretoria.

Target 3: Development of models with protocols for plant conservation and sustainable use, based on research and practical experience

DIEDERICH, N., MANDER, M., CROUCH, N., SPRING, W., MCKEAN, S. & SYMMONDS, R. 2003. *Knowing and growing muthi*. INR/Share-Net Publication, Scottsville/Hawick.

NICHOLS, G. 2005. *Growing rare plants. A practical handbook on propagating the threatened plants of southern Africa*. Southern African Botanical Diversity Network Report No. 36. SABONET, Pretoria.

SCHEMSKE, D.W., HUSBAND, B.C., RUCKELSHAUS, M.H., GOODWILLIE, C., PARKER, I.M. & BISHOP, J.G. 1994. Evaluating approaches to the conservation of rare and endangered plants. *Ecology* 75,3: 584–606.

Target 4: At least 10 per cent of each of the world's ecological regions effectively conserved

MUCINA, L., RUTHERFORD, M.C. & POWRIE, L.W. (eds) 2005. *Vegetation Map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps*. South African National Biodiversity Institute, Pretoria.

MUCINA, L. & RUTHERFORD, M.C. (eds) In prep. *Vegetation of South Africa, Lesotho and Swaziland*. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Target 5: Protection of 50 per cent of the most important areas for plant diversity assured

DESMET, P. 2004. *Identification of IPA mapping regions for South Africa using PRECIS data*. Unpublished report, SABONET, Pretoria.

DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A.T., NEL, J., TURPIE, J.K., COWLING, R.M., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K. & STRAUSS, T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. *Strelitzia* 17. South African National Biodiversity Institute, Pretoria.

SMITH, T.J. 2005. Important Plant Areas in southern Africa. Combined proceedings of workshops held in Mozambique, Namibia and South Africa. Southern African Botanical Diversity Network Report No. 39. SABONET, Pretoria.

VAN WYK, A.E. & SMITH, G.F. 2001. *Regions of floristic endemism in southern Africa. A review with emphasis on succulents*. Umदाus Press, Pretoria.

Target 6: At least 30 per cent of production lands managed consistent with the conservation of plant diversity

DEAT 2005. *South Africa's National Biodiversity Strategy and Action Plan*. Department of Environmental Affairs and Tourism, Pretoria.

DONALDSON, J.D., TURPIE, J. & OETTLER, N. In prep. *Conservation farming: finding the balance between productive land use and biodiversity conservation in agricultural landscapes*.

SANDWITH, T., MAZE, K., BARNETT, M., FRAZEE, S. & CADMAN, M. 2005. Mainstreaming biodiversity through South Africa's bioregional conservation programmes: top-down and bottom-up. In C. Petersen & B. Huntley (eds), *Mainstreaming biodiversity in production landscapes*. Working Paper, GEF.

Target 7: 60 per cent of the world's threatened species conserved *in situ*

DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A., NEL, J., TURPIE, J.K., COWLING, R., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K. & STRAUSS, T. 2004. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. *Strelitzia* 17. South African National Biodiversity Institute, Pretoria.

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT 2004. *Government Gazette*, 7 June 2004. Act No. 10 2004: 48–56.

Target 8: 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes

AKERROYD, J. & WYSE JACKSON, P. 1995. *A handbook for botanic gardens on the reintroduction of plants to the wild*. Botanic Gardens Conservation International.

BOTHA, D.J., WILLIS, C.K. & WINTER, J.H.S. 2000. Southern African botanical gardens needs assessment. Southern African Botanical Diversity Network Report No. 11. SABONET, Pretoria.

- CROUCH, N. 2001. The role of horticulture in threatened species conservation. *SABONET News* 6,3: 185–188.
- DONALDSON, J. (ed.) 2003. *Cycads. Status Survey and Conservation Action Plan*. IUCN/SSC Cycad Specialist Group.
- GOLDING, J. & HEILGENDORFF, H. 2002. *An evaluation of the extent to which the National Botanical Gardens contribute to the ex situ conservation of South Africa's threatened plants: results*. Occasional Report of the Directorate: Biodiversity Policy & Planning. National Botanical Institute, Pretoria.
- LEADLAY, E. 1993. Developing the BGCI database on botanic gardens and their collections worldwide. *Botanic Gardens Conservation News* 2,2: 61–64.
- LEADLAY, E. & GREENE, J. (eds) 1998. *The Darwin Technical Manual for Botanic Gardens*. BGCI, Richmond.
- LEADLAY, E., SHARROCK, S. & SIMIYU, S. 2005. The BGCI contribution to the implementation of the Global Strategy for Plant Conservation. *BGjournal* 2,2: 3–7.
- MAUNDER, M. 1992. Plant reintroduction: an overview. *Biodiversity and Conservation* 1: 51–61.
- MAUNDER, M. 1993. Practical aspects of plant conservation for a botanical garden: the relationship between botanical gardens and wild habitat. *Boissiera* 47: 155–165.
- MAUNDER, M. 1994. Botanic gardens: future challenges and responsibilities. *Biodiversity and Conservation* 3: 97–103.
- MAUNDER, M. & CULHAM, A. 1998. The role of botanic gardens in supporting plant reintroductions. *Dodonea* 65: 81–90.
- MAUNDER, M., FAY, M. & UPSON, T. 1993. *Ex situ and in situ approaches to plant conservation: two distinct options or complementary points on the conservation spectrum?* In M. Groves, M. Read & B.A. Thomas (eds), *Species endangered by trade: a role for horticulture*. Fauna and Flora Preservation Society, London.
- MAUNDER, M., HIGGENS, S. & CULHAM, A. 2001. The effectiveness of botanic garden collections in supporting plant conservation: a European case study. *Biodiversity and Conservation* 10: 383–401.
- NICHOLS, G. 2005. Growing rare plants. A practical handbook on propagating the threatened plants of southern Africa. *Southern African Botanical Diversity Network Report No. 36*. SABONET, Pretoria.
- RUIZ, M. & POOMA, R. 2000. *Going home: a manual on the repatriation of information from ex-situ conservation and research institutions to countries of origin*. Royal Botanic Gardens, Kew.
- SHARROCK, S. 2004. Databases and local action: progress from BGCI on ex situ conservation. *Plant Talk* 38: 34, 35.
- SMITH, G.F., BROWN, N.A.C., BOTHA, D.J., RUTHERFORD, M.C., DONALDSON, J.S., DE LANGE, J.H. & DAVIS, G.W. 1999. Horticultural research in the National Botanical Institute of South Africa: past achievements and future directions. *South African Journal of Science* 95: 344–348.
- WILLIS, C.K. 2005. National Botanical Gardens: embassies of South Africa's biodiversity and culture. *BGjournal* 2,2: 9–12.
- WILLIS, C.K. 2006. SANBI: institutional response to implementing the International Agenda. *BGjournal* 3,1: 11–13.
- WILLIS, C.K. & HITCHCOCK, A. 2001. Threatened plants and southern African botanical gardens. *SABONET News* 6,3: 183, 184.
- WILLIS, C.K. & SMITH, G.F. 2004. The Global Strategy for Plant Conservation: implications for succulent plant conservation in southern Africa. *Aloe* 41,1: 6–15.
- WILLIS, C.K. & TURNER, S. (eds) 2001. *Action plan for southern African botanical gardens*. *Southern African Botanical Diversity Network Report No. 12*. SABONET, Pretoria.
- WINTER, J.H.S. & BOTHA, D.J. 1994. The release of endangered plants into the horticultural trade: conservation or exploitation? *Biodiversity and Conservation* 3: 142–147.
- WYSE JACKSON, P.S. 2004. Developing international targets for botanic gardens in conservation: a consultation document. *BGjournal* 1,1: 4–6.
- WYSE JACKSON, P.S. & SUTHERLAND, L.A. 2000. *International Agenda for Botanic Gardens in Conservation*. Botanic Gardens Conservation International, London.
- WYSE JACKSON, P.S., GIBBS, D. & DULLOO, E. 2003. Global Strategy for Plant Conservation: Target 8. *Botanic Gardens Conservation News* 4,1: 27–30.

WYSE JACKSON, P.S., LEADLAY, E. & HOBSON, C. 1999. A review of international conventions which affect the work of botanic gardens. *Botanic Gardens Conservation News* 3,2: 29–54.

Target 9: 70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated local and indigenous knowledge maintained

GERMISHUIZEN, G. & MEYER, N.L. (eds) 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.

LOCK, J.M. 1989. *Legumes of Africa. A check-list*. Royal Botanic Gardens, Kew.

Target 10: Management plans in place for at least 100 major invasive alien species that threaten plants, plant communities and associated habitats and ecosystems

HENDERSON, L. 1995. *Plant invaders of southern Africa: a pocket field guide to the identification of 161 of the most important and potentially important alien species*. Plant Protection Research Institute Handbook No. 5. Agricultural Research Council, Pretoria.

HENDERSON, L. 2001. *Alien weeds and invasive plants*. Plant Protection Research Institute Handbook No. 12. Agricultural Research Council, Pretoria.

HENDERSON, L. & CILLIERS, C.J. 2002. *Invasive aquatic plants*. Plant Protection Research Institute Handbook No. 16. Agricultural Research Council, Pretoria.

HENDERSON, M., FOURIE, D.M.C., WELLS, M.J. & HENDERSON, L. 1987. *Declared weeds and alien invader plants in South Africa*. Department of Agriculture and Water Supply, Pretoria.

MACDONALD, I.A.W., KRUGER, F.J. & FERRAR, A.A. (eds) 1986. *The ecology and management of biological invasions in southern Africa*. Oxford University Press, Cape Town.

MORRIS, M.J., WOOD, A.R. & DEN BREEËN, A. 1999. Plant pathogens and biological control of weeds in South Africa: a review of projects and progress during the last decade. *African Entomology Memoir* No. 1: 129–137.

RICHARDSON, D.M., MACDONALD, I.A.W., HOFFMANN, J.H. & HENDERSON, L. 1997. Alien plant invasions. In R.M. Cowling, D.M. Richardson & S.M. Pierce (eds), *Vegetation of southern Africa*: 535–570. Cambridge University Press, Cambridge.

ROBERTSON, M.P., VILLET, M.H., FAIRBANKS, D.H.K., HENDERSON, L., HIGGINS, S.I., HOFFMAN, J.H., LE MAITRE, D.C., PALMER, A.R., RIGGS, I., SHACKLETON, C.M. & ZIMMERMAN, H.G. 2003. A proposed prioritization system for the management of invasive alien plants in South Africa. *South African Journal of Science* 99: 37–43.

WELLS, M.J., BALSINHAS, A.A., JOFFE, H., ENGELBRECHT, V.M., HARDING, G. & STIRTON, C.H. 1986. A catalogue of problem plants in southern Africa incorporating the National Weed List of South Africa. *Memoirs of the Botanical Survey of South Africa*. No. 53. Botanical Research Institute, Pretoria.

Target 11: No species of wild flora endangered by international trade

MARSHALL, N.T. 1998. *Searching for a cure: conservation of medicinal wildlife resources in east and southern Africa*. TRAFFIC International, Cambridge, UK.

NEWTON, D.J. & BODASING, A. 1994. TRAFFIC, wildlife trade monitoring and the South African plant trade. In B.J. Huntley (ed.), *Botanical diversity in southern Africa*. *Strelitzia* 1. National Botanical Institute, Pretoria.

RAIMONDO, D., NEWTON, D., FELL, C., DONALDSON, J.S. & DICKSON, B. 2005. Devil's Claw, *Harpagophytum* spp. in South Africa: conservation and livelihoods issues. *Traffic Bulletin* 20,3: 99–112.

Target 12: 30 per cent of plant-based products derived from sources that are sustainably managed

BOTHA, J., WITKOWSKI, E.T.F. & SHACKLETON, C.M. 2004. Market profiles and trade in medicinal plants in the Lowveld, South Africa. *Environmental Conservation* 31,1: 38–46.

DIEDERICH, N. 2005. Plants for fibre. In M. Mander & M. McKenzie (eds), *Southern African Trade Directory of Indigenous Natural Products*: 9–16. Commercial Products from the Wild Group, Department of Forest and Wood Science, Stellenbosch University, Stellenbosch.

DZEREFO, C.M. 2004. Sustainable harvesting of medicinal plant resources in the Abe Bailey Nature Reserve, Gauteng. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 464–467. University of KwaZulu-Natal Press, Scottsville.

EARTHTRENDS 2003. *Forests, grasslands, and drylands*. South Africa. Country Profiles, World Resources Institute, Washington, DC.

GRACE, O.M., PRENDERGAST, H.D.V., VAN STADEN, J. & JAGER, A.K. 2002. The status of bark in South African traditional health care. *South African Journal of Botany* 68: 21–30.

HANSEN, T. & TREASURE, C. 2005. Why a Biodiversity & Wine Initiative? Press Release, Meropa Communications. October 15, 2005. http://www.evt.org.za/news_fullstory.aspx?newsID=235

HALL, W. 2005. Health conscious step into crisp world of organic food. *Business Day*. November 2, 2005.

JÄGER, A.K., McGAW, L.-J., GRACE, O.M. & VAN STADEN, J. 2004. Success stories of South African bioprospecting. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 504. University of KwaZulu-Natal Press, Scottsville.

MANDER, M. & MCKENZIE, M. (eds) 2005. *Southern African Trade Directory of Indigenous Natural Products*. Commercial Products from the Wild Group, Department of Forest and Wood Science, Stellenbosch University, Stellenbosch. <http://www.cpwild.co.za/Docs.htm>

PFAB, M.F. 2004. Is the collection of *Aloe peglerae* from the wild sustainable? An evaluation using stochastic population modelling. *Biological Conservation* 118: 695–701.

SHACKLETON, C.M. 2001. Re-examining local and market-orientated use of wild species for the conservation of biodiversity. *Environmental Conservation* 28,3: 270–278.

SHACKLETON, C. & SHACKLETON, S. 2004. The importance of non-timber forest products in rural livelihood security and as safety nets: a review of evidence from South Africa. *South African Journal of Science* 100: 658–664.

SHACKLETON, S.E. & STEENKAMP, C. 2004. The woodcraft industry in the Mpumalanga-Limpopo Province Lowveld. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 399–435. University of KwaZulu-Natal Press, Scottsville.

STAFFORD, G.I. 2004. Indigenous knowledge and medicinal plant product development in South Africa. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 494–497. University of KwaZulu-Natal Press, Scottsville.

STEWART, K.M. & COLE, D. 2005. The commercial harvest of devil's claw (*Harpagophytum* spp.) in southern Africa: The devil's in the details. *Journal of Ethnopharmacology* 100: 225–236.

WILLIAMS, V.L. 2004. Trade and socio-economic value of forest and woodland resources within the medicinal plant market in Johannesburg. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 439–472. University of KwaZulu-Natal Press, Scottsville.

WORLD WIDE FUND FOR NATURE. 2005. *WWF South Africa Annual Review 2005*. Stellenbosch. <http://www.panda.org.za/publications.php>

Target 13: The decline of plant resources, and associated indigenous and local knowledge, innovations and practices that support sustainable livelihoods, local food security and health care, halted

ARNOLD, T.H., PRENTICE, C.A., HAWKER, L.C., SNYMAN, E.E., TOMALIN, M., CROUCH, N.R. & POTTAS-BIRCHER, C. 2002. Medicinal and magical plants of southern Africa: an annotated checklist. *Strelitzia* 13. National Botanical Institute, Pretoria.

COCKS, M.L., DOLD, A.P. & GRUNDY, I.M. 2004. The trade in medicinal plants from forests in the Eastern Cape Province. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 473–492. University of KwaZulu-Natal Press, Scottsville.

CROUCH, N.R. 2001. The role of horticulture in threatened species conservation. *SABONET News* 6,3: 185–188.

CROUCH, N.R. & EDWARDS, T. 2004. Ethnomedicinal (*muthi*) plant nurseries. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 658–661, 675–678. University of KwaZulu-Natal Press, Scottsville.

CROUCH, N.R. & HUTCHINGS, A. 1999. Zulu healer *muthi* gardens: inspiration for botanic garden displays and community outreach projects. Proceedings of the 5th International Botanic Gardens Conservation Congress. [http://www.bgci.org.uk/congress_1998_cape/html/crouch.htm]

CROUCH, N.R., SMITH, G.F., LÖTTER, M. & SYMMONDS, R. 2003. *Encephalartos woodii*: the first historically documented *muthi* casualty in southern Africa. *Encephalartos* 73: 22, 25–28.

CROUCH, N., SYMMONDS, R., SPRING, W. & DIEDERICH, N. 2006. Fact sheets for growing popular medicinal plant species. In N. Diederichs (ed.), *Commercialising medicinal plants. A southern African guide*: 99–142. Sun Press, Stellenbosch.

- CUNNINGHAM, A.B. 1988. *An investigation of the herbal medicine trade in Notal/KwaZulu*. Investigational Report No. 29. Institute of Natural Resources, University of Natal, Pietermaritzburg.
- DIEDERICH, N. (ed.) 2006. *Commercialising medicinal plants. A southern African guide*. Sun Press, Stellenbosch.
- DOLD, A.P. & COCKS, M.L. 2002. The trade in medicinal plants in the Eastern Cape Province, South Africa. *South African Journal of Science* 98: 589–597.
- FOX, F.W. & NORWOOD YOUNG, M.E. 1982. *Food from the veld: edible wild plants of southern Africa*. Delta Books, Craighall.
- GERSTNER, J. 1946. Some factors affecting the perpetuation of our indigenous silva. *Journal of the South African Forestry Association* 1: 4–11.
- KYLE, R. 2004. Resource use in the indigenous forests of Maputland: are conservation strategies working? In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 713–736. University of KwaZulu-Natal Press, Scottsville.
- LAWES, M.J., MIDGLEY, J.J. & CHAPMAN, C.A. 2004. South Africa's forests: the ecology and sustainable use of indigenous timber resources. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 31–75. University of KwaZulu-Natal Press, Scottsville.
- LAWES, M.J., OBIRI, J.A.F. & EELEY, H.A.C. 2004. The uses and value of indigenous forest resources in South Africa. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 227–273. University of KwaZulu-Natal Press, Scottsville.
- MANDER, M. 1997. *Medicinal plant marketing and strategies for sustaining the plant supply in the Bushbuckridge area and Mpumalanga Province*. DANCED/DWAF Report.
- MANDER, M. 1998. *The marketing of medicinal plants in South Africa: a case study in KwaZulu-Natal*. FAO of the UN, Rome.
- MANDER, M. 2004. An overview of the medicinal plant market in South Africa. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 440–445. University of KwaZulu-Natal Press, Scottsville.
- MANDER, M., MANDER, J., CROUCH, N., McKEAN, S. & NICHOLS, G. 1999. *Ukutsholo nokwazi imithi yokuwelopho*. Share-Net Publications, Catchment Action Series, Howick.
- MARSHALL, N. 1998. *Searching for a cure: conservation of medicinal wildlife resources in East and southern Africa*. TRAFIC International, Cambridge, UK.
- MULHOLLAND, D.A. & DREWES, S.E. 2004. Global phytochemistry: indigenous medicinal chemistry on track in southern Africa. *Phytochemistry* 65: 769–782.
- NICHOLS, G. 2005. Growing rare plants: a practical handbook on propagating the threatened plants of southern Africa. *Southern African Botanical Diversity Network Report No. 36*. SABONET, Pretoria.
- SHACKLETON, C.M. & SHACKLETON, S.E. 2004. Use of woodland resources for direct household provisioning. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 195–225. University of KwaZulu-Natal Press, Scottsville.
- SMITH, C.A. 1966. Common names of South African plants. *Memoirs of the Botanical Survey of South Africa* No. 35. Botanical Research Institute, Pretoria.
- SPRING, W. & DIEDERICH, N. 2006. Farming medicinal plants. In N. Diederichs (ed.), *Commercialising medicinal plants. A southern African guide*: 69–85. Sun Press, Stellenbosch.
- TODD, C.B., KHOROMBI, K., VAN DER WAAL, B.C.W. & WEISSER, P.J. 2004. Conservation of woodland biodiversity: a complementary traditional and western approach towards protecting Brackenridgeo zonguebarica. In M.J. Lawes, H.A.C. Eeley, C.M. Shackleton & B.G.S. Geach (eds), *Indigenous forests and woodlands in South Africa: policy, people and practice*: 737–750. University of KwaZulu-Natal Press, Scottsville.
- VON AHLEFELDT, D., CROUCH, N.R., NICHOLS, G., SYMMONDS, R., McKEAN, S., SIBIYA, H. & CELE, P. 2003. *Medicinal plants traded on South Africa's eastern seaboard*. Ethekwin Parks Department & University of Natal, Durban.
- WATT, J.M. & BREYER-BRANDWIJK, M.G. 1962. *The medicinal and poisonous plants of southern and eastern Africa*. E. & S. Livingstone Ltd., Edinburgh and London.
- WILLIAMS, V.L. 2003. Hawkers of health: an investigation of the Faraday Street traditional medicine market in Johannesburg, Gauteng. *Plant Ecology and Conservation Series* No. 15. University of the Witwatersrand, Johannesburg.

Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, educational and public-awareness programmes

CARO, T.M., PELKEY, N. & GRIGIONE, M. 1994. Effects of conservation biology education on attitudes towards nature. *Conservation Biology* 8,3: 846–852.

DAVIS, G. 2005. Biodiversity conservation as a social bridge in the urban context: Cape Town's sense of 'The Urban Imperative' to protect its biodiversity & empower its people. In T. Trzyna (ed.), *The urban imperative*. California Institute of Public Affairs, Sacramento.

TOUVAL, J.L. & DIETZ, J.M. 1994. The problem of teaching conservation problem solving. *Conservation Biology* 8,3: 902–904.

TROMBULAK, S.C. 1994. Undergraduate education and the next generation of conservation biologists. *Conservation Biology* 8,2: 589–591.

Target 15: The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this strategy

HUNTLEY, B.J., WILLIS, C.K., SMITH, G.F. & SIEBERT, S.J. 2002. SABONET: its history and success in southern Africa. In H. Baijnath & Y. Singh (eds), *Rebirth of science in Africa: a shared vision for life and environmental sciences*: 231–246. Umduus Press, Hatfield.

HUNTLEY, B.J., MATOS, E.M., AYE, T.T., NERMARK, U., NAGENDRAN, C.R., SEYANI, J.H., DA SILVA, M.A.C., IZIDINE, S., MAGGS, G.L., MANNHEIMER, C., KUBIRSKIE, R., SMITH, G.F., KOEKEMOER, M., DLAMINI, G.M., PHIRI, P.S.M., NOBANDA, N. & WILLIS, C.K. 1998. Inventory, evaluation and monitoring of botanical diversity in southern Africa: a regional capacity and institution building network (SABONET). *Southern African Botanical Diversity Network Report No. 4*. SABONET, Pretoria.

PRIVETT, S.D.J., HEYDENRYCH, B.J. & COWLING, R.M. 2002. Putting biodiversity to business on the Agulhas Plain. In S.M. Pierce, R.M. Cowling, T. Sandwith & K. MacKinnon (eds), *Mainstreaming biodiversity in development: case studies from South Africa*: 101–115. The International Bank for Reconstruction and Development/THE WORLD BANK, Washington D.C.

WALMSLEY, R.D., WALMSLEY, J.J. & ANATI, A. 1994. Botanical diversity: education, training facilities and human resources in South Africa. In B.J. Huntley (ed.), *Botanical diversity in southern Africa*: 201–210. *Strelitzia* 1. National Botanical Institute, Pretoria.

WILLIS, C.K. & HUNTLEY, B.J. 2001. SABONET: developing capacity within southern Africa's herbaria and botanical gardens. *Systematics and Geography of Plants* 71: 247–258.

Target 16: Networks for plant conservation activities established or strengthened at national, regional and international levels

HUNTLEY, B.J., WILLIS, C.K., SMITH, G.F. & SIEBERT, S.J. 2002. SABONET: its history and success in southern Africa. In H. Baijnath & Y. Singh (eds), *Rebirth of science in Africa: a shared vision for life and environmental sciences*: 231–246. Umduus Press, Hatfield.

HUNTLEY, B.J., MATOS, E.M., AYE, T.T., NERMARK, U., NAGENDRAN, C.R., SEYANI, J.H., DA SILVA, M.A.C., IZIDINE, S., MAGGS, G.L., MANNHEIMER, C., KUBIRSKIE, R., SMITH, G.F., KOEKEMOER, M., DLAMINI, G.M., PHIRI, P.S.M., NOBANDA, N. & WILLIS, C.K. 1998. Inventory, evaluation and monitoring of botanical diversity in southern Africa: a regional capacity and institution building network (SABONET). *Southern African Botanical Diversity Network Report No. 4*. SABONET, Pretoria.

LOCHNER, P., WEAVER, A., GELDERBLOM, C., PEART, R., SANDWITH, T. & FOWKES, S. 2003. Aligning the diverse: the development of a biodiversity conservation strategy for the Cape Floristic Region. *Biological Conservation* 112: 29–44.

McNEELY, J.A., MOONEY, H.A., NEVILLE, L.E., SCHEI, P. & WAAGE, J.K. (eds) 2001. *Global Strategy on Invasive Alien Species*. IUCN on behalf of the Global Invasive Species Programme, Gland, Switzerland and Cambridge, UK.

MITTERMEIER, R.A., KORMOS, C.F., MITTERMEIER, C.G., GIL, P.R., SANDWITH, T. & BESANÇON, C. 2005. *Transboundary conservation, a new vision for protected areas*. CEMEX-Agrupación Sierra Madre-Conservation International, Mexico City.

SANDWITH, T., MAZE, K., BARNETT, M., FRAZEE, S. & CADMAN, M. 2005. Mainstreaming biodiversity through South Africa's bioregional conservation programmes: top-down and bottom-up. In C. Petersen & B. Huntley (eds), *Mainstreaming biodiversity in production landscapes*: 78–90. Global Environment Facility, Washington, D.C.

SANDWITH, T., YOUNGE, A., WARNER, C., SEKHRAN, N., DINU-WRIGHT, A. & CARRET, J.-C. 2004. Linking mountains to lowlands for biodiversity conservation in the Cape Floristic Region. In D. Harmon & G. Worboys, *Managing mountain protected areas: challenges and responses for the 21st century*: 116–125. Andromeda Press, Colledara (Teramo).

STEENKAMP, Y., SIEBERT, S.J., SMITH, G.F., HUNTLEY, B.J. & WILLIS, C.K. 2006. Final Project Report. Looking back on the SABONET Project: a triumph of regional cooperation. *Southern African Botanical Diversity Network Report* No. 43. SABONET, Pretoria.

VAN JAARSVELD, A.S. & BIGGS, H.C. 2000. Broad participation enhances initial steps towards a South African ecosystem observatory system (LTER). *South African Journal of Science* 96: 63–66.

WILLIS, C.K. (ed.) 2004. African Botanic Gardens Congress 'Partnerships and Linkages'. Proceedings of a congress held at Durban Botanic Gardens, South Africa 24–29 November 2002./ Congrès des Jardins Botaniques Africains 'Relations et Partenariats'. Compte rendu d'un congrès tenu dans les Jardins Botaniques de Durban, Afrique du Sud 24–29 Novembre 2002. *Southern African Botanical Diversity Network Report* No. 22. SABONET, Pretoria.

WILLIS, C.K. & HUNTLEY, B.J. 2001. SABONET: developing capacity within southern Africa's herbaria and botanical gardens. *Systematics and Geography of Plants* 71: 247–258.



Shepherd tree (*Boscia albitrunca*) or 'tree of life' growing in the Richtersveld, part of the Succulent Karoo Region (Gariep Centre of Floristic Endemism) in the northwestern corner of the Northern Cape. The area is regarded as South Africa's only mountainous desert and is topographically and geologically complex, with a preponderance of leaf succulents.

Photograph: Christopher K. Willis

Glossary

angiosperms: flowering plants; seed-bearing plants whose ovules, and hence seeds, develop within an enclosed ovary; angiosperms are subdivided into **monocotyledons** and **dicotyledons**; compare to **gymnosperms**.

biodiversity: the variety of genes, species and ecosystems that constitute life on earth.

biome: a broad ecological unit representing major life zones of large natural areas. In South Africa biomes are defined mainly by vegetation structure and climate.

botanical garden: an institution holding documented collections of living plants for the purposes of scientific research, conservation, display and education.

bryophytes: a division of the plant kingdom comprising the liverworts (Hepatophyta), mosses (Bryophyta) and hornworts (Anthocerotophyta).

bulb: an underground storage organ with fleshy, scaly leaves on a foreshortened stem.

critically endangered: a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

cryptogams: the so-called 'lower plants'; nonflowering plants in which reproduction is by means of spores rather than seeds; the whole reproductive apparatus is rather inconspicuous or hidden, making up a small, less obvious part of the plant body (include algae, fungi, **bryophytes**, lichens and **pteridophytes**); compare to **phanerogams**.

dicotyledons: those species of flowering plants (**angiosperms**) that have two cotyledons (the leaf-like organs that first appear after a seed germinates).

endangered: a taxon is Endangered when it is not **Critically Endangered**, but is facing a very high risk of extinction in the wild in the near future.

endemic: having a natural distribution that is confined to a particular geographical region.

ex situ conservation: also known as off-site conservation; the conservation and maintenance of samples of organisms outside of their natural habitat, usually in the form of seed, pollen, vegetative propagules, tissue or cell cultures or individuals; compare to **in situ conservation**.

exotic: not **indigenous**; an introduced plant.

forest: a vegetation type composed primarily of large trees with overlapping canopies, under which are characteristically a small **tree** layer, a **shrub** stratum and a **herb** layer.

grassland: a vegetation type dominated by grasses. When a quantity of trees are present, it is termed a wooded grassland.

gymnosperms: plants having their seeds exposed or naked, not enclosed in an ovary; in South Africa this group includes the **indigenous** yellowwoods, cedars, cypresses and cycads; compare to **angiosperms**.

habitat: the environment in which a plant or animal lives.

herb: a plant whose stem is not woody or persistent. Usually confined to seed plants.

hotspot: an area which, at the global scale, has exceptional concentrations of species with high levels of endemism and also faces exceptional threats of destruction.

in situ conservation: also known as on-site conservation; the conservation of biological diversity in nature; compare to **ex situ conservation**.

indigenous: occurring naturally in a particular, defined area.

inflorescence: a flower cluster.

invasive alien: an alien species whose introduction and/or spread threatens biological diversity. The term 'invasive alien species' shall be deemed the same as 'alien invasive species'.

monocotyledons: those species of flowering plants (**angiosperms**) that have one cotyledon (a leaf-like organ that first appears after a seed germinates); examples are grasses, orchids, sedges, **bulbs**, aloes, restios and lilies; compare to **dicotyledons**.

naturalised: introduced from another region, reproducing freely from seed, and competing successfully with **indigenous** plants.

nonvascular plants: plants that lack water or solute-conducting tissue; include algae, **bryophytes**, lichen and fungi; compare to **vascular plants**.

phanerogams: seed-bearing plants that display their reproductive mechanisms prominently, as cones or flower heads (include **gymnosperms** and **angiosperms**); compare to **cryptogams**.

pteridophytes: ferns or fern-like plants.

reintroduction: the release and management of a plant into an area in which it formerly occurred, but in which it is now extinct or believed to be extinct.

shrub: a woody, perennial plant with two to several stems arising from or near the ground; compare to **tree**.

succulent: thick, fleshy, often with water-storing tissue; usually an adaptation to withstand long periods of drought such as found in arid regions.

sustainable use: the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

taxon (pl. **taxa**): any unit of classification into which a living organism fits, for example a family, genus, species, subspecies or variety.

taxonomy: the study of the principles and practice of classification.

threatened: pertaining to plants that fall within one of the three IUCN Red List categories of **Critically Endangered** (CR), **Endangered** (EN) or **Vulnerable** (VU).

tree: a woody, perennial plant normally with a single stem or bole and a distinct upper crown.

vascular plants: plants that possess water and solute-conducting tissue; include the **gymnosperms**, **pteridophytes** and **angiosperms**.

veld type: a well-known delimitation of vegetation types in South Africa carried out by John Acocks in 1953, in which he designated 'veld types' based on areas of similar agricultural land-use potential.

vulnerable: a taxon is Vulnerable when it is not **Critically Endangered** or **Endangered**, but is facing a high risk of extinction in the wild in the medium-term future.

woodland: a vegetation type composed largely of trees, with the crowns of the trees well-spaced apart or just touching and with only a herb layer beneath the canopy; compare to **forest**.

xerophyte (adj. **xerophytic**): a plant that is adapted to dry or arid habitats.

Appendix 1

Summary of the 16 Global Strategy for Plant Conservation targets, institutions facilitating stakeholder consultations on the individual global targets and links with the Convention on Biological Diversity and key international initiatives

GSPC Target	International institution(s) facilitating stakeholder consultations	Article(s) of the CBD and decisions of the CoP	Key programmes and cross-cutting initiatives under the CBD	Key international initiatives
OBJECTIVE 1: UNDERSTANDING AND DOCUMENTING PLANT DIVERSITY				
1. A widely accessible working list of plant species, as a step towards a complete world flora.	Royal Botanic Gardens, Kew	Articles 7 and 9	Global Taxonomy Initiative	International Plant Names Index (IPNI), Global Biodiversity Information Facility (GBIF)
2. A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels.	IUCN—The World Conservation Union	Articles 7 and 8	Thematic programmes	IUCN—Species Survival Commission
3. Development of models with protocols for plant conservation and sustainable use, based on research and practical experience.	Cross-cutting target: no lead agency/institution	Articles 8, 9, 10 and 12	Thematic programmes	DIVERSITAS
OBJECTIVE 2: CONSERVING PLANT DIVERSITY				
4. At least 10 per cent of each of the world's ecological regions effectively conserved.	No lead agency/institution	Article 8	Thematic programmes; Protected Areas, Ecosystem Approach	IUCN—World Commission on Protected Areas; UNESCO Man and the Biosphere Programme
5. Protection of 50 per cent of the most important areas for plant diversity assured.	Plantlife International and IUCN	Article 8	Thematic programmes; Protected Areas, Ecosystem Approach	UNESCO Man and the Biosphere Programme; Important Plant Areas Programme; IUCN—World Commission on Protected Areas

OBJECTIVE 2: CONSERVING PLANT DIVERSITY (continued)

6. At least 30 per cent of production lands managed consistent with the conservation of plant diversity	Food and Agriculture Organization (FAO) and International Plant Genetic Resources Institute (IPGRI)	Articles 8 and 10, Decision III/11	Agricultural biodiversity, forest biodiversity, biodiversity of dry and subhumid lands; Ecosystem Approach	Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture; Collaborative Partnership on Forests
7. 60 per cent of the world's threatened species conserved <i>in situ</i> .	UNEP—World Conservation Monitoring Centre	Article 8	Thematic programmes; Protected Areas, Ecosystem Approach	IUCN—World Commission on Protected Areas and Species Survival Commission
8. 60 per cent of threatened plant species in accessible <i>ex situ</i> collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes.	Botanic Gardens Conservation International and IPGRI	Article 9	Thematic programmes	International Agenda for Botanic Gardens in Conservation, FAO network of <i>ex situ</i> collections
9. 70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated local and indigenous knowledge maintained.	FAO and IPGRI	Articles 8 and 9	Agricultural biodiversity, forest biodiversity	Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture
10. Management plans in place for at least 100 major invasive alien species that threaten plants, plant communities and associated habitats and ecosystems.	Global Invasive Species Programme (GISP)	Article 8	Invasive alien species; thematic programmes	International Plant Protection Convention; Global Invasive Species Programme

OBJECTIVE 3: USING PLANT DIVERSITY SUSTAINABLY

11. No species of wild flora endangered by international trade.	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Article 10	Sustainable use; thematic programmes	CITES
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OBJECTIVE 3: USING PLANT DIVERSITY SUSTAINABLY (continued)

12. 30 per cent of plant-based products derived from sources that are sustainably managed.	FAO and IPGRI	Article 10	Agricultural biodiversity; forest biodiversity; sustainable use; incentive measures	Various certification schemes such as those of the International Organic Agriculture Service and the Forest Stewardship Council
13. The decline of plant resources, and associated local and indigenous knowledge, innovations and practices that support sustainable livelihoods, local food security and health care, halted.	FAO, IPGRI and People and Plants International	Articles 8 and 10	Agricultural biodiversity, forest biodiversity, sustainable use	Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture, UNDP/FAO sustainable livelihoods programme

OBJECTIVE 4: PROMOTING EDUCATION AND AWARENESS ABOUT PLANT DIVERSITY

14. The importance of plant diversity and the need for its conservation incorporated into communication, education and public-awareness programmes.	Cross-cutting target: Botanic Gardens Conservation International	Article 13	Communication, education and public awareness	Education and public awareness: implementation of the Global Initiative on Biological Diversity Education and Public Awareness
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OBJECTIVE 5: BUILDING CAPACITY FOR THE CONSERVATION OF PLANT DIVERSITY

15. The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this strategy.	Cross-cutting target: no lead agency/institution	Article 12	Global Taxonomy Initiative and thematic programmes	No key international initiatives
16. Networks for plant conservation activities established or strengthened at national, regional and international levels.	Cross-cutting target: no lead agency/institution	Articles 17 and 18	Global Taxonomy Initiative and thematic programmes	International Agenda for Botanic Gardens in Conservation; IUCN—Species Survival Commission; BioNet International

Appendix 2

Useful website addresses

AFRISCO Pty

<http://www.afrisco.net>

Agribusiness in Sustainable Natural African Plant Products

<http://www.asnapp.org.za>

Agricultural Research Council (ARC)

<http://www.arc.agric.za>

Biodiversity and Wine Initiative

<http://www.bwi.co.za>

BioNET International

<http://www.bionet-intl.org>

Botanic Gardens Conservation International (BGCI)

<http://www.bgci.org>

Botanical Society of South Africa

<http://www.botanicalsociety.org.za>

Briza Publications

<http://www.briza.co.za>

Cape Action for People and the Environment (C.A.P.E.)

<http://www.capeaction.org.za>

Cape Nature

<http://www.capenature.org.za>

Children in Distress (CINDI)

<http://www.cindi.org.za>

Convention on Biological Diversity (CBD)

<http://www.biodiv.org>

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

<http://www.cites.org>

Council for Scientific and Industrial Research (CSIR)

<http://www.csir.co.za>

Critical Ecosystem Partnership Fund (CEPF)

<http://www.cepf.net>

Dendrological Society of South Africa

<http://www.dendro.co.za>

DIVERSITAS

<http://www.diversitas-international.org>

DST-NRF Centre of Excellence for Invasion Biology (CIB)

<http://academic.sun.ac.za/cib/index.htm>

Fauna and Flora International (FFI)

<http://www.fauna-flora.org>

Fernwood Press

<http://www.fernwoodpress.co.za>

Flower Valley Conservation Trust

<http://www.flowervalley.org.za>

Food and Agriculture Organization of the United Nations (FAO)

<http://www.fao.org>

Food & Trees for Africa (FTFA)
<http://www.trees.co.za>

Forest Stewardship Council
<http://www.fsc.org>

Global Invasive Species Programme (GISP)
<http://www.gisp.org>

Global Partnership for Plant Conservation (GPPC)
<http://www.plants2010.org>

Global Strategy for Plant Conservation (GSPC)
<http://www.iucn.org/themes/ssc/news/globalplantstrategy.html>
<http://www.plant-talk.org/gspc>
<http://www.bgci.org/conservation/strategy.html>

Global Trees Campaign
<http://www.globaltrees.org>

Green Futures Horticulture and Life Skills College
<http://www.greenfutures.co.za>

International Plant Genetic Resources Institute (IPGRI)
<http://www.ipgri.cgiar.org>

International Plant Names Index (IPNI)
<http://www.ipni.org>

IUCN Red List of Threatened Species
<http://www.redlist.org>

IUCN/Species Survival Commission (IUCN/SSC)
<http://www.iucn.org/themes/SSC>

Jacana Media
<http://www.jacana.co.za>

Medicinal Plants Database for South Africa (MEDBASE)
<http://www.sanbi.org/>

Millennium Seed Bank Project (MSBP)
<http://www.rbgekew.org.uk/msbp>

National Department of Agriculture (NDA)
<http://www.nda.agric.za>

National Department of Environmental Affairs and Tourism (DEAT)
<http://www.environment.gov.za>

National Department of Water Affairs and Forestry (DWAF)
<http://www.dwaf.gov.za>

Novel Drug Development Platform (NDDP)
<http://www.sahealthinfo.org/noveldrug/>

Organic Agricultural Association of South Africa
<http://www.oaasa.co.za>

People and Plants
<http://www.kew.org/peopleplants>

Phycological Society of Southern Africa (PSSA)
<http://www.botany.uwc.ac.za/pssa>

PhytoTrade Africa
<http://www.phytotradafrica.com>

Plant Protection Research Institute (PPRI)
<http://www.arc.agric.za/institutes/ppri>

Plant Talk
<http://www.plant-talk.org>

Planta Europa–European Plant Conservation Strategy
http://www.plantaeuropa.org/html/plant_conservation_strategy.htm

Plantlife International
<http://www.plantlife.org.uk>

Re-introduction Specialist Group of IUCN's Species Survival Commission
<http://www.iucnssrcsg.org>

Royal Botanic Gardens, Kew, UK
<http://www.kew.org>

Southern African Botanical Diversity Network (SABONET)
<http://www.sabonet.org.za>

South African National Biodiversity Institute (SANBI)
<http://www.sanbi.org>

South African National Parks (SANParks)
<http://www.sanparks.org>

South African Nursery Association (SANA)
<http://www.sana.co.za>

South African Traditional Medicines Database (TRAMED)
<http://www.mrc.ac.za/Tramed3/>

Struik Publishers
<http://www.struik.co.za>

Subtropical Thicket Ecosystem Programme (STEP)
<http://cpu.uwc.ac.za/step.htm#step>

Succulent Karoo Ecosystem Programme (SKEP)
<http://www.skep.org>

Succulent Society of South Africa
<http://www.succulents.net>

Threatened Plants Database
<http://www.unep-wcmc.org/species/plants/overview.htm>

Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC)
<http://www.traffic.org>

Umdaus Press
<http://www.succulents.net/umdaus/>

United Nations Educational, Scientific and Cultural Organisation (UNESCO)
<http://www.unesco.org>

Wildlife and Environment Society of South Africa (WESSA)
<http://www.wessa.org.za>

World Conservation Monitoring Centre (WCMC)
<http://www.unep-wcmc.org>

World Conservation Union (IUCN)
<http://www.iucn.org>

World Conservation Union in South Africa
<http://www.iucnsa.org.za>

World Resources Institute
http://www.earthtrends.wri.org/country_profiles/

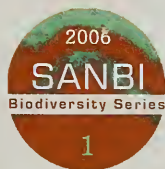
World Wide Fund for Nature (WWF)
<http://www.panda.org>

Appendix 3

Abbreviations and Acronyms

ABGN	African Botanic Gardens Network
ABSA	Amalgamated Banks of South Africa
APCD	African Plant Checklist and Database
ARC	Agricultural Research Council
ARC-LBD	Agricultural Research Council-Livestock Business Division
ASNAPP	Agribusiness in Sustainable Natural African Plant Products
BGCI	Botanic Gardens Conservation International
BotSoc	Botanical Society of South Africa
C.A.P.E.	Cape Action for People and the Environment
CBD	Convention on Biological Diversity
CCESSA	Cryo-Conservation Centre of Excellence for Sub-Saharan Africa
CEPF	Critical Ecosystem Partnership Fund
CFR	Cape Floristic Region
CIB	Centre for Invasion Biology
CINDI	Children in Distress
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoP	Conference of the Parties
CPWild	Commercial Products from the Wild
CREW	Custodians of Rare and Endangered Wildflowers
CSIR	Council for Scientific and Industrial Research
CU	Conservation Unit (of Botanical Society of South Africa)
DEAT	Department of Environmental Affairs and Tourism
DEG	German Development Bank
DNA	Deoxyribonucleic Acid
DST	Department of Science and Technology
DWAF	Department of Water Affairs and Forestry
EE	Environmental Education
EPWP	Expanded Public Works Programme
FAO	Food and Agriculture Organisation of the United Nations
FFI	Fauna and Flora International
FRD	Foundation for Research Development
FSA	Flora of southern Africa
FTFA	Food & Trees for Africa
GBIF	Global Biodiversity Information Facility
GEF	Global Environment Facility
GISP	Global Invasive Species Programme
GPPC	Global Partnership for Plant Conservation
GSPC	Global Strategy for Plant Conservation
GTI	Global Taxonomy Initiative
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IA	International Agenda for Botanic Gardens in Conservation
IPA	Important Plant Area
IPGRI	International Plant Genetic Resources Institute
IPNI	International Plant Names Index
IPW	Integrated Production of Wine
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	World Conservation Union
IUCN ROSA	World Conservation Union's Regional Office for southern Africa
IUCN/SSC	World Conservation Union/Species Survival Commission
KCA	Kenilworth Conservation Area
MDTP	Maloti-Drakensberg Transfrontier Project
MEDBASE	National Medicinal Plants Database for South Africa
MRC	Medical Research Council

MSBP	Millennium Seed Bank Project
NBG	National Botanical Garden
NBI	National Botanical Institute
NBSAP	National Biodiversity Strategy and Action Plan
NDA	National Department of Agriculture
NDDP	Novel Drug Development Platform
NEMBA	National Environmental Management: Biodiversity Act
NEPAD	New Partnership for Africa's Development
NETCAB	Network and Capacity Building Programme for southern Africa
NGO	Nongovernmental Organisation
NPGRC	National Plant Genetic Resources Centre
NPP	Nurseries Partnership Programme
NRF	National Research Foundation
NSBA	National Spatial Biodiversity Assessment
PAP	Protea Atlas Project
PHVA	Population and Habitat Viability Analysis
POSA	Plants of Southern Africa
PRECIS	National Herbarium, Pretoria (PRE) Computerised Information System
PSSA	Phycological Society of Southern Africa
PVA	Population Viability Analysis
QDS	Quarter Degree Square
R&D	Research and Development
RDL	Red Data List
SABONET	Southern African Botanical Diversity Network
SADC	Southern African Development Community
SAEON	Southern African Environmental Observatory Network
SANA	South African Nursery Association
SANBI	South African National Biodiversity Institute
SAPIA	Southern African Plant Invaders Atlas
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SEED	Sustainable Energy, Environment and Development Programme
SKEP	Succulent Karoo Ecosystem Programme
SKR	Succulent Karoo Region
SPPFW	Species Plantarum-Flora of the World Programme
STEP	Subtropical Thicket Ecosystem Programme
TMNP	Table Mountain National Park
TRAFFIC	Trade Records Analysis of Flora and Fauna in Commerce
TRAMED	South African Traditional Medicines Database
TSD	Threatened Species Dossier
TSP	Threatened Species Programme
UCT	University of Cape Town
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WCMC	World Conservation Monitoring Centre
WESSA	Wildlife and Environment Society of South Africa
WFW	Working for Water Programme
WHO	World Health Organisation
WWF-SA	World Wide Fund for Nature, South Africa



SANBI Biodiversity Series 1

1. Conserving South Africa's plants: a South African response to the Global Strategy for Plant Conservation. 2006. C.K. Willis (ed.). ISBN 1-919976-28-0.

Other technical publications by the South African National Biodiversity Institute

- *Bothalia*, a journal of botanical research.
- *Strelitzia*, a series of occasional publications on the southern African flora and vegetation.
- *Flowering Plants of Africa*, a serial presenting colour plates of African plants with accompanying text.
- *Flora of southern Africa (FSA)*, taxonomic treatises on the flora of South Africa, Lesotho, Swaziland, Namibia and Botswana. Contributions also appear in *Bothalia*.

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South African National Biodiversity Institute

The South African National Biodiversity Institute (SANBI) was established on 1 September 2004 through the signing into force of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004 by President Thabo Mbeki. The Act expands the mandate of the former National Botanical Institute to include responsibilities relating to the full diversity of South Africa's fauna and flora, and builds on the internationally respected programmes in conservation, research, education and visitor services developed by the National Botanical Institute and its predecessors over the past century.

The vision of SANBI is to be the leading institution in biodiversity science in Africa, facilitating conservation, sustainable use of living resources, and human well-being.

SANBI's mission is to promote the sustainable use, conservation, appreciation and enjoyment of the exceptionally rich biodiversity of South Africa, for the benefit of all people.

SANBI Biodiversity Series will publish occasional reports on projects, technologies, workshops, symposia and other activities initiated by or executed in partnership with SANBI.



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